

## **Chapter : 9. MEAN, MEDIAN, MODE OF GROUPED DATA, CUMULATIVE FREQUENCY GRAPH AND OGIVE**

### **Exercise : 9A**

#### **Question: 1**

If the mean of 5

#### **Solution:**

Mean of the observation is given by -

$$\text{Mean} = \frac{\text{Sum of the given observations}}{\text{Total number of observations}}$$

So, adding the given observations, we get

$$\begin{aligned}\text{Sum of the given observations} &= x + (x + 2) + (x + 4) + (x + 6) + (x + 8) \\ &= x + x + 2 + x + 4 + x + 6 + x + 8 \\ &= 5x + 20\end{aligned}$$

Total number of observations = 5

Mean = 11 (Given)

$$\text{Mean} = \frac{5x + 20}{5}$$

$$\Rightarrow 11 = \frac{5x + 20}{5}$$

$$\Rightarrow 55 = 5x + 20$$

$$\Rightarrow 5x = 55 - 20 = 35$$

$$\Rightarrow x = 7$$

Thus,  $x = 7$

#### **Question: 2**

If the mean of 25

#### **Solution:**

Mean of the observation is given by -

$$\text{Mean} = \frac{\text{Sum of the given observations}}{\text{Total number of observations}}$$

Total number of observations = 25

Mean of 25 observation = 27 (Given)

We get

$$27 = \frac{\text{Sum of 25 observations}}{25}$$

$$\Rightarrow \text{Sum of 25 observations} = 27 \times 25 = 675$$

If each observation is decreased by 7, the Sum gets affected.

$$\text{New Sum} = 675 - (25 \times 7) = 675 - 175 = 500$$

$$\text{New mean} = \frac{500}{25} = 20$$

Thus, new mean = 20

**Question: 3**

Compute the mean

**Solution:**

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|-------|----------------------|--------------------|-----------|
| 1 - 3 | 2                    | 12                 | 24        |
| 3 - 5 | 4                    | 22                 | 88        |
| 5 - 7 | 6                    | 27                 | 162       |
| 7 - 9 | 8                    | 19                 | 152       |
| TOTAL |                      | 80                 | 426       |

We have got

$$\sum f_i = 20 \text{ & } \sum f_i x_i = 426$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{426}{80}$$

$$\Rightarrow \bar{x} = 5.325$$

Thus, mean is 5.325

**Question: 4**

Find the mean, us

**Solution:**

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|---------|----------------------|--------------------|-----------|
| 0 - 10  | 5                    | 7                  | 35        |
| 10 - 20 | 15                   | 5                  | 75        |
| 20 - 30 | 25                   | 6                  | 150       |
| 30 - 40 | 35                   | 12                 | 420       |
| 40 - 50 | 45                   | 8                  | 360       |
| 50 - 60 | 55                   | 2                  | 110       |
| TOTAL   |                      | 40                 | 1150      |

We have got

$$\sum f_i = 40 \text{ & } \sum f_i x_i = 1150$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{1150}{40}$$

$$\Rightarrow \bar{x} = 28.75$$

Thus, mean is 28.75

### Question: 5

Calculate the mea

### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|---------|----------------------|--------------------|-----------|
| 25 - 35 | 30                   | 6                  | 180       |
| 35 - 45 | 40                   | 10                 | 400       |
| 45 - 55 | 50                   | 8                  | 400       |
| 55 - 65 | 60                   | 12                 | 720       |
| 65 - 75 | 70                   | 4                  | 280       |
| TOTAL   |                      | 40                 | 1980      |

We have got

$$\sum f_i = 40 \text{ & } \sum f_i x_i = 1980$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{1980}{40}$$

$$\Rightarrow \bar{x} = 49.5$$

Thus, mean is 49.5

### Question: 6

Compute the mean

### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS     | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|-----------|----------------------|--------------------|-----------|
| 0 - 100   | 50                   | 6                  | 300       |
| 100 - 200 | 150                  | 9                  | 1350      |
| 200 - 300 | 250                  | 15                 | 3750      |
| 300 - 400 | 350                  | 12                 | 4200      |
| 400 - 500 | 450                  | 8                  | 3600      |
| TOTAL     |                      | 50                 | 13200     |

We have got

$$\sum f_i = 50 \text{ & } \sum f_i x_i = 13200$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow \bar{x} = \frac{13200}{50}$$

$$\Rightarrow \bar{x} = 264$$

Thus, mean is 264

### Question: 7

Using an appropri

### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS     | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|-----------|----------------------|--------------------|-----------|
| 84 - 90   | 87                   | 8                  | 696       |
| 90 - 96   | 93                   | 10                 | 930       |
| 96 - 102  | 99                   | 16                 | 1584      |
| 102 - 108 | 105                  | 23                 | 2415      |
| 108 - 114 | 111                  | 12                 | 1332      |
| 114 - 120 | 117                  | 11                 | 1287      |
| TOTAL     |                      | 80                 | 8244      |

We have got

$$\sum f_i = 80 \text{ & } \sum f_i x_i = 8244$$

∴ mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{8244}{80}$$

$$\Rightarrow \bar{x} = 103.05$$

Thus, mean is 103.05

Here, the method being used is direct method as it is easy to calculate the mid - points of the class intervals and the rest calculations were simple and easy.

### Question: 8

If the mean of th

### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|---------|----------------------|--------------------|-----------|
| 0 - 10  | 5                    | 3                  | 15        |
| 10 - 20 | 15                   | 4                  | 60        |
| 20 - 30 | 25                   | p                  | 25p       |
| 30 - 40 | 35                   | 3                  | 105       |
| 40 - 50 | 45                   | 2                  | 90        |
| TOTAL   |                      | 12 + p             | 270 + 25p |

We have got

$$\sum f_i = 12 + p \text{ & } \sum f_i x_i = 270 + 25p$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow 24 = \frac{270 + 25p}{12 + p}$$

$$\Rightarrow 288 + 24p = 270 + 25p$$

$$\Rightarrow 25p - 24p = 288 - 270$$

$$\Rightarrow p = 18$$

Thus, p is 18

### Question: 9

The following dis

### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| DAILY POCKET ALLOWANCE (Rs.) | MID - POINT( $x_i$ ) | NUMBER OF CHILDREN ( $f_i$ ) | $f_i x_i$   |
|------------------------------|----------------------|------------------------------|-------------|
| 11 - 13                      | 12                   | 7                            | 84          |
| 13 - 15                      | 14                   | 6                            | 84          |
| 15 - 17                      | 16                   | 9                            | 144         |
| 17 - 19                      | 18                   | 13                           | 234         |
| 19 - 21                      | 20                   | $f$                          | $20f$       |
| 21 - 23                      | 22                   | 5                            | 110         |
| 23 - 25                      | 24                   | 4                            | 96          |
| TOTAL                        |                      | $44 + f$                     | $752 + 20f$ |

We have got

$$\Sigma f_i = 44 + f \text{ and } \Sigma f_i x_i = 752 + 20f$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow 18 = \frac{752 + 20f}{44 + f} \quad (\because \text{given: mean of pocket allowance is 18})$$

$$\Rightarrow 792 + 18f = 752 + 20f$$

$$\Rightarrow 20f - 18f = 792 - 752$$

$$\Rightarrow 2f = 40$$

$$\Rightarrow f = 20$$

Thus,  $f$  is 20.

### Question: 10

If the mean of th

**Solution:**

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS    | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$    |
|----------|----------------------|--------------------|--------------|
| 0 - 20   | 10                   | 7                  | 70           |
| 20 - 40  | 30                   | p                  | 30p          |
| 40 - 60  | 50                   | 10                 | 500          |
| 60 - 80  | 70                   | 9                  | 630          |
| 80 - 100 | 90                   | 13                 | 1170         |
| TOTAL    |                      | $39 + p$           | $2370 + 30p$ |

We have got

$$\Sigma f_i = 39 + p \text{ and } \Sigma f_i x_i = 2370 + 30p$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow 54 = \frac{2370 + 30p}{39 + p} (\because \text{given: mean of pocket allowance is 54})$$

$$\Rightarrow 2106 + 54p = 2370 + 30p$$

$$\Rightarrow 54p - 30p = 2370 - 2106$$

$$\Rightarrow 24p = 264$$

$$\Rightarrow p = 11$$

Thus, p is 11.

**Question: 11**

The mean of the f

**Solution:**

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$          |
|---------|----------------------|--------------------|--------------------|
| 0 - 10  | 5                    | 7                  | 35                 |
| 10 - 20 | 15                   | 10                 | 150                |
| 20 - 30 | 25                   | x                  | 25x                |
| 30 - 40 | 35                   | 13                 | 455                |
| 40 - 50 | 45                   | y                  | 45y                |
| 50 - 60 | 55                   | 10                 | 550                |
| 60 - 70 | 65                   | 14                 | 910                |
| 70 - 80 | 75                   | 9                  | 675                |
| TOTAL   |                      | $63 + x + y$       | $2775 + 25x + 45y$ |

We have got

$$\Sigma f_i = 63 + x + y \text{ and } \Sigma f_i x_i = 2775 + 25x + 45y$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow 42 = \frac{2775 + 25x + 45y}{63 + x + y} \quad (\because \text{given: mean of pocket allowance is 42})$$

$$\Rightarrow 2646 + 42x + 42y = 2775 + 25x + 45y$$

$$\Rightarrow 42x - 25x + 42y - 45y = 2775 - 2646$$

$$\Rightarrow 17x - 3y = 129 \dots(i)$$

As given in the question, frequency( $\Sigma f_i$ ) = 100

And as calculated by us, frequency ( $\Sigma f_i$ ) =  $63 + x + y$

Equalizing them, we get

$$63 + x + y = 100$$

$$\Rightarrow x + y = 37 \dots \text{(ii)}$$

We will now solve equations (i) and (ii), multiply eq.(ii) by 3 and then add it to eq.(i), we get

$$(17x - 3y) + [3(x + y)] = 129 + 111$$

$$\Rightarrow 17x - 3y + 3x + 3y = 240$$

$$\Rightarrow 20x = 240$$

$$\Rightarrow x = 12$$

Substitute  $x = 12$  in equation (ii),

$$12 + y = 37$$

$$\Rightarrow y = 37 - 12$$

$$\Rightarrow y = 25$$

Thus,  $x = 12$  and  $y = 25$ .

### Question: 12

The daily expendi

#### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| EXPENDITURE<br>(Rs.) | MID -<br>POINT( $x_i$ ) | NUMBER OF<br>FAMILIES( $f_i$ ) | $f_i x_i$                |
|----------------------|-------------------------|--------------------------------|--------------------------|
| 140 - 160            | 150                     | 5                              | 750                      |
| 160 - 180            | 170                     | 25                             | 4250                     |
| 180 - 200            | 190                     | $f_1$                          | $190f_1$                 |
| 200 - 220            | 210                     | $f_2$                          | $210f_2$                 |
| 220 - 240            | 230                     | 5                              | 1150                     |
| TOTAL                |                         | $35 + f_1 + f_2$               | $6150 + 190f_1 + 210f_2$ |

We have got

$$\Sigma f_i = 35 + f_1 + f_2 \text{ and } \Sigma f_i x_i = 6150 + 190f_1 + 210f_2$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow 188 = \frac{6150 + 190f_1 + 210f_2}{35 + f_1 + f_2} \quad (\because \text{given: mean of pocket allowance is 188})$$

$$\Rightarrow 6580 + 188f_1 + 188f_2 = 6150 + 190f_1 + 210f_2$$

$$\Rightarrow 190f_1 - 188f_1 + 210f_2 - 188f_2 = 6580 - 6150$$

$$\Rightarrow 2f_1 + 22f_2 = 430 \dots(\text{i})$$

As given in the question, frequency( $\Sigma f_i$ ) = 100

And as calculated by us, frequency ( $\Sigma f_i$ ) =  $35 + f_1 + f_2$

Comparing them, we get

$$35 + f_1 + f_2 = 100$$

$$\Rightarrow f_1 + f_2 = 65 \dots(\text{ii})$$

We will now solve equations (i) and (ii), multiply eq.(ii) by 2 and then subtracting it from eq.(i), we get

$$(2f_1 + 22f_2) - [2(f_1 + f_2)] = 430 - 130$$

$$\Rightarrow 2f_1 + 22f_2 - 2f_1 - 2f_2 = 300$$

$$\Rightarrow 20f_2 = 300$$

$$\Rightarrow f_2 = 15$$

Substitute  $f_2 = 15$  in equation (ii),

$$f_1 + 15 = 65$$

$$\Rightarrow f_1 = 65 - 15$$

$$\Rightarrow f_1 = 50$$

Thus,  $f_1 = 50$  and  $f_2 = 15$ .

### Question: 13

The mean of the f

### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS     | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$              |
|-----------|----------------------|--------------------|------------------------|
| 0 - 20    | 10                   | 7                  | 70                     |
| 20 - 40   | 30                   | $f_1$              | $30f_1$                |
| 40 - 60   | 50                   | 12                 | 600                    |
| 60 - 80   | 70                   | $f_2$              | $70f_2$                |
| 80 - 100  | 90                   | 8                  | 720                    |
| 100 - 120 | 110                  | 5                  | 550                    |
| TOTAL     |                      | $32 + f_1 + f_2$   | $1940 + 30f_1 + 70f_2$ |

We have got

$$\Sigma f_i = 32 + f_1 + f_2 \text{ and } \Sigma f_i x_i = 1940 + 30f_1 + 70f_2$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow 57.6 = \frac{1940 + 30f_1 + 70f_2}{32 + f_1 + f_2} (\because \text{given: mean of pocket allowance is 57.6})$$

$$\Rightarrow 1843.2 + 57.6f_1 + 57.6f_2 = 1940 + 30f_1 + 70f_2$$

$$\Rightarrow 57.6f_1 - 30f_1 + 57.6f_2 - 70f_2 = 1940 - 1843.2$$

$$\Rightarrow 27.6f_1 - 12.4f_2 = 96.8$$

$$\Rightarrow 69f_1 - 31f_2 = 242 \dots(i)$$

As given in the question, frequency( $\Sigma f_i$ ) = 50

And as calculated by us, frequency ( $\Sigma f_i$ ) =  $32 + f_1 + f_2$

Comparing them, we get

$$32 + f_1 + f_2 = 50$$

$$\Rightarrow f_1 + f_2 = 18 \dots(ii)$$

We will now solve equations (i) and (ii), multiply eq.(ii) by 31 and then adding to eq.(i), we get

$$(69f_1 - 31f_2) + [31(f_1 + f_2)] = 242 + 558$$

$$\Rightarrow 69f_1 - 31f_2 + 31f_1 + 31f_2 = 800$$

$$\Rightarrow 100f_1 = 800$$

$$\Rightarrow f_1 = 8$$

Substitute  $f_1 = 8$  in equation (ii),

$$8 + f_2 = 18$$

$$\Rightarrow f_2 = 18 - 8$$

$$\Rightarrow f_2 = 10$$

Thus,  $f_1 = 8$  and  $f_2 = 10$ .

### Question: 14

During a medical

#### Solution:

We will find the mean heartbeats per minute by direct method.

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|---------|----------------------|--------------------|-----------|
| 65 - 68 | 66.5                 | 2                  | 133       |
| 68 - 71 | 69.5                 | 4                  | 278       |
| 71 - 74 | 72.5                 | 3                  | 217.5     |
| 74 - 77 | 75.5                 | 8                  | 604       |
| 77 - 80 | 78.5                 | 7                  | 549.5     |
| 80 - 83 | 81.5                 | 4                  | 326       |
| 83 - 86 | 84.5                 | 2                  | 169       |
| TOTAL   |                      | 30                 | 2277      |

We have got

$$\Sigma f_i = 30 \text{ & } \Sigma f_i x_i = 2277$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{2277}{30}$$

$$\Rightarrow \bar{x} = 75.9$$

Thus, mean is 75.9 heartbeats per minute.

### Question: 15

Find the mean marks per student using Assumed - mean method, where A = Assumed

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | DEVIATION( $d_i$ ) | $f_i d_i$ |
|---------|----------------------|--------------------|--------------------|-----------|
|         |                      |                    | $d_i = x_i - 25$   |           |
| 0 - 10  | 5                    | 12                 | - 20               | - 240     |
| 10 - 20 | 15                   | 18                 | - 10               | - 180     |
| mean.   | 25 = A               | 27                 | 0                  | 0         |
| 30 - 40 | 35                   | 20                 | 10                 | 200       |
| 40 - 50 | 45                   | 17                 | 20                 | 340       |
| 50 - 60 | 55                   | 6                  | 30                 | 180       |
| TOTAL   |                      | 100                |                    | 300       |

We have got

$$A = 25, \Sigma f_i = 100 \text{ & } \Sigma f_i d_i = 300$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i d_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = 25 + \frac{300}{100}$$

$$\Rightarrow \bar{x} = 28$$

Thus, mean is 28.

### Question: 16

Find the mean of

#### Solution:

We will find the mean of the frequency distribution using Assumed - mean method, where A =

| Assumed mean. | CLASS     | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | DEVIATION( $d_i$ )        | $f_i d_i$ |
|---------------|-----------|----------------------|--------------------|---------------------------|-----------|
|               | 100 - 120 | 110                  | 10                 | $d_i = x_i - 150$<br>- 40 | - 400     |
|               | 120 - 140 | 130                  | 20                 | - 20                      | - 400     |
|               | 140 - 160 | 150 = A              | 30                 | 0                         | 0         |
|               | 160 - 180 | 170                  | 15                 | 20                        | 300       |
|               | 180 - 200 | 190                  | 5                  | 40                        | 200       |
|               | TOTAL     |                      | 80                 |                           | - 300     |

We have got

$$A = 150, \sum f_i = 80 \text{ & } \sum f_i d_i = - 300$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i d_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = 150 - \frac{300}{80}$$

$$\Rightarrow \bar{x} = 146.25$$

Thus, mean is 146.25.

**Question: 17**

Find the mean of

**Solution:**

We will find the mean of the data using Assumed - mean method, where A = Assumed mean.

| CLASS     | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | DEVIATION( $d_i$ ) | $f_i d_i$ |
|-----------|----------------------|--------------------|--------------------|-----------|
|           |                      |                    | $d_i = x_i - 50$   |           |
| 0 - 20    | 10                   | 20                 | - 40               | - 800     |
| 20 - 40   | 30                   | 35                 | - 20               | - 700     |
| 40 - 60   | 50 = A               | 52                 | 0                  | 0         |
| 60 - 80   | 70                   | 44                 | 20                 | 880       |
| 80 - 100  | 90                   | 38                 | 40                 | 1520      |
| 100 - 120 | 110                  | 31                 | 60                 | 1860      |
| TOTAL     |                      | 220                |                    | 2760      |

We have got

$$A = 50, \sum f_i = 220 \text{ & } \sum f_i d_i = 2760$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum f_i d_i}{\sum f_i}$$

$$\Rightarrow \bar{x} = 50 + \frac{2760}{220}$$

$$\Rightarrow \bar{x} = 62.55$$

Thus, mean is 62.55.

**Question: 18**

The following tab

**Solution:**

We will solve this using direct method.

| LITERACY RATE(%) | MID - POINT( $x_i$ ) | NUMBER OF CITIES( $f_i$ ) | $f_i x_i$ |
|------------------|----------------------|---------------------------|-----------|
| 45 - 55          | 50                   | 4                         | 200       |
| 55 - 65          | 60                   | 11                        | 660       |
| 65 - 75          | 70                   | 12                        | 840       |
| 75 - 85          | 80                   | 9                         | 720       |
| 85 - 95          | 90                   | 4                         | 360       |
| TOTAL            |                      | 40                        | 2780      |

We have got

$$\sum f_i = 40 \text{ and } \sum f_i x_i = 2780$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow \bar{x} = \frac{2780}{40}$$

$$\Rightarrow \bar{x} = 69.5$$

Thus, mean is 69.5%.

### Question: 19

Find the mean of

#### Solution:

We will find the mean of the frequency distribution using step - deviation method, where A = Assumed mean and h = length of class interval.

Here, let A = 25 and h = 10

| CLASS   | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 25$ | FREQUENCY( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|---------|----------------------|--|--------------------|---------------|-----------|
| 0 - 10  | 5                    | - 20                                   | 7                  | - 2           | - 14      |
| 10 - 20 | 15                   | - 10                                   | 10                 | - 1           | - 10      |
| 20 - 30 | 25 = A               | 0                                      | 15                 | 0             | 0         |
| 30 - 40 | 35                   | 10                                     | 8                  | 1             | 8         |
| 40 - 50 | 45                   | 20                                     | 10                 | 2             | 20        |
| TOTAL   |                      |  | 50                 |               | 4         |

We have got

$$A = 25, h = 10, \sum f_i = 50 \text{ & } \sum f_i u_i = 4$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 25 + \frac{4}{50} \times 10$$

$$\Rightarrow \bar{x} = 25.8$$

Thus, mean is 25.8

### Question: 20

Find the mean of

#### Solution:

We will find the mean of the data using step - deviation method, where  $A$  = Assumed mean and  $h$  = length of class interval.

Here, let  $A = 40$  and  $h = 10$

| CLASS   | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 40$ | FREQUENCY( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|---------|----------------------|--|--------------------|---------------|-----------|
| 5 - 15  | 10                   | - 30                                   | 6                  | - 3           | - 18      |
| 15 - 25 | 20                   | - 20                                   | 10                 | - 2           | - 20      |
| 25 - 35 | 30                   | - 10                                   | 16                 | - 1           | - 16      |
| 35 - 45 | 40 = A               | 0                                      | 15                 | 0             | 0         |
| 45 - 55 | 50                   | 10                                     | 24                 | 1             | 24        |
| 55 - 65 | 60                   | 20                                     | 8                  | 2             | 16        |
| 65 - 75 | 70                   | 30                                     | 7                  | 3             | 21        |
| TOTAL   |                      |  | 86                 |               | 7         |

We have got

$$A = 40, h = 10, \sum f_i = 86 \text{ & } \sum f_i u_i = 7$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 40 + \frac{7}{86} \times 10$$

$$\Rightarrow \bar{x} = 40.81$$

Thus, mean is 40.81

### Question: 21

The weights of te

### Solution:

We will find the mean weight of packet using step - deviation method, where  $A = \text{Assumed mean}$  and  $h = \text{length of class interval}$ .

Here, let A = 202.5 and h = 1

| WEIGHT(g) | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 202.5$ | NUMBER OF PACKETS( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|-----------|----------------------|---|----------------------------|---------------|-----------|
| 200 - 201 | 200.5                | - 2                                       | 13                         | - 2           | - 26      |
| 201 - 202 | 201.5                | - 1                                       | 27                         | - 1           | - 27      |
| 202 - 203 | 202.5 = A            | 0   | 18                         | 0             | 0         |
| 203 - 204 | 203.5                | 1   | 10                         | 1             | 10        |
| 204 - 205 | 204.5                | 2   | 1                          | 2             | 2         |
| 205 - 206 | 205.5                | 3   | 1                          | 3             | 3         |
| TOTAL     |                      |   | 70                         |               | - 38      |

We have got

$$A = 202.5, h = 1, \sum f_i = 70 \text{ & } \sum f_i u_i = -38$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 202.5 - \frac{-38}{70} \times 1$$

$$\Rightarrow \bar{x} = 201.96$$

Thus, mean is 201.96 g.

### Question: 22

Find the mean of

#### Solution:

We will find the mean of the frequency distribution using step - deviation method, where A = Assumed mean and h = length of class interval.

Here, let A = 45 and h = 10

| CLASS   | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 45$ | FREQUENCY( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|---------|----------------------|--|--------------------|---------------|-----------|
| 20 - 30 | 25                   | - 20                                   | 25                 | - 2           | - 50      |
| 30 - 40 | 35                   | - 10                                   | 40                 | - 1           | - 40      |
| 40 - 50 | 45 = A               | 0                                      | 42                 | 0             | 0         |
| 50 - 60 | 55                   | 10                                     | 33                 | 1             | 33        |
| 60 - 70 | 65                   | 20                                     | 10                 | 2             | 20        |
| TOTAL   |                      |  | 150                |               | - 37      |

We have got

$$A = 45, h = 10, \sum f_i = 150 \text{ & } \sum f_i u_i = - 37$$

∴ mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 45 - \frac{37}{150} \times 10$$

$$\Rightarrow \bar{x} = 42.53$$

Thus, mean is 42.53.

### Question: 23

In an annual exam

#### Solution:

We will find the mean marks using step - deviation method, where A = Assumed mean and h = length of class interval.

Here, let A = 37.5 and h = 15

| MARKS OBTAINED | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 37.5$ | NUMBER OF STUDENTS( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|----------------|----------------------|--|-----------------------------|---------------|-----------|
| 0 - 15         | 7.5                  | - 30                                     | 2                           | - 2           | - 4       |
| 15 - 30        | 22.5                 | - 15                                     | 4                           | - 1           | - 4       |
| 30 - 45        | 37.5 = A             | 0  | 5                           | 0             | 0         |
| 45 - 60        | 52.5                 | 15                                       | 20                          | 1             | 20        |
| 60 - 75        | 67.5                 | 30                                       | 9                           | 2             | 18        |
| 75 - 90        | 82.5                 | 45                                       | 10                          | 3             | 30        |
| TOTAL          |                      |  | 50                          |               | 60        |

We have got

$$A = 37.5, h = 15, \sum f_i = 50 \text{ & } \sum f_i u_i = 60$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 37.5 + \frac{60}{50} \times 15$$

$$\Rightarrow \bar{x} = 55.5$$

Thus, mean marks are 55.5.

#### Question: 24

Find the arithmetic

#### Solution:

We will find the mean of the frequency distribution using step - deviation method, where  $A$  = Assumed mean and  $h$  = length of class interval.

Here, let  $A = 33$  and  $h = 6$

| AGE(years) | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 33$ | NUMBER OF WORKERS( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|------------|----------------------|--|----------------------------|---------------|-----------|
| 18 - 24    | 21                   | - 12                                   | 6                          | - 2           | - 12      |
| 24 - 30    | 27                   | - 6                                    | 8                          | - 1           | - 8       |
| 30 - 36    | 33 = A               | 0                                      | 12                         | 0             | 0         |
| 36 - 42    | 39                   | 6                                      | 8                          | 1             | 8         |
| 42 - 48    | 45                   | 12                                     | 4                          | 2             | 8         |
| 48 - 54    | 51                   | 18                                     | 2                          | 3             | 6         |
| TOTAL      |                      |  | 40                         |               | 2         |

We have got

$$A = 33, h = 6, \sum f_i = 40 \text{ & } \sum f_i u_i = 2$$

∴ mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 33 + \frac{2}{40} \times 6$$

$$\Rightarrow \bar{x} = 33.3$$

Thus, mean age is 33.3 years.

### Question: 25

Find the mean of

### Solution:

We will find the mean of the frequency distribution using step - deviation method, where A = Assumed mean and h = length of class interval.

Here, let A = 550 and h = 20

| CLASS     | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 550$ | FREQUENCY( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|-----------|----------------------|---|--------------------|---------------|-----------|
| 500 - 520 | 510                  | - 40                                    | 14                 | - 2           | - 28      |
| 520 - 540 | 530                  | - 20                                    | 9                  | - 1           | - 9       |
| 540 - 560 | 550 = A              | 0                                       | 5                  | 0             | 0         |
| 560 - 580 | 570                  | 20                                      | 4                  | 1             | 4         |
| 580 - 600 | 590                  | 40                                      | 3                  | 2             | 6         |
| 600 - 620 | 610                  | 60                                      | 5                  | 3             | 15        |
| TOTAL     |                      |   | 40                 |               | - 12      |

We have got

$$A = 550, h = 20, \sum f_i = 40 \text{ & } \sum f_i u_i = -12$$

∴ mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 550 - \frac{12}{40} \times 20$$

$$\Rightarrow \bar{x} = 544$$

Thus, mean is 544.

### Question: 26

Find the mean age

#### Solution:

We will find the mean age using step - deviation method, where  $A$  = Assumed mean and  $h$  = length of class interval.

Here, let  $A = 42$  and  $h = 5$

Since, the class intervals are inclusive type, we'll first convert it into exclusive type by extending the class interval from both the ends.

| AGE(years)  | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 550$ | NUMBER OF PERSONS( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|-------------|----------------------|---|----------------------------|---------------|-----------|
| 24.5 - 29.5 | 27                   | - 15                                    | 4                          | - 3           | - 12      |
| 29.5 - 34.5 | 32                   | - 10                                    | 14                         | - 2           | - 28      |
| 34.5 - 39.5 | 37                   | - 5                                     | 22                         | - 1           | - 22      |
| 39.5 - 44.5 | 42 = A               | 0                                       | 16                         | 0             | 0         |
| 44.5 - 49.5 | 47                   | 5                                       | 6                          | 1             | 6         |
| 49.5 - 54.5 | 52                   | 10                                      | 5                          | 2             | 10        |
| 54.5 - 59.5 | 57                   | 15                                      | 3                          | 3             | 9         |
| TOTAL       |                      |   | 70                         |               | - 37      |

We have got

$$A = 42, h = 5, \sum f_i = 70 \text{ & } \sum f_i u_i = - 37$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 42 - \frac{37}{70} \times 5$$

$$\Rightarrow \bar{x} = 39.36$$

Thus, mean age is 544 years.

### Question: 27

The following tab

**Solution:**

We will find the average age using step - deviation method, where A = Assumed mean and h = length of class interval.

Here, let A = 29.5 and h = 10

Since, the class intervals are inclusive type, we'll first convert it into exclusive type by extending the class interval from both the ends.

| AGE(years)  | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 29.5$ | NUMBER OF CASES( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|-------------|----------------------|--|--------------------------|---------------|-----------|
| 4.5 - 14.5  | 9.5                  | - 20                                     | 6                        | - 2           | - 12      |
| 14.5 - 24.5 | 19.5                 | - 10                                     | 11                       | - 1           | - 11      |
| 24.5 - 34.5 | 29.5 = A             | 0  | 21                       | 0             | 0         |
| 34.5 - 44.5 | 39.5                 | 10                                       | 23                       | 1             | 23        |
| 44.5 - 54.5 | 49.5                 | 20                                       | 14                       | 2             | 28        |
| 54.5 - 64.5 | 59.5                 | 30                                       | 5                        | 3             | 15        |
| TOTAL       |                      |  | 80                       |               | 43        |

We have got

$$A = 29.5, h = 10, \sum f_i = 80 \text{ & } \sum f_i u_i = 43$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum f_i u_i}{\sum f_i} \times h$$

$$\Rightarrow \bar{x} = 29.5 + \frac{43}{80} \times 10$$

$$\Rightarrow \bar{x} = 34.88$$

Thus, mean age is 34.88 years.

**Question: 28**

Weight of 60 eggs

**Solution:**

We will find the mean weight using step - deviation method, where A = Assumed mean and h = length of class interval.

Here, let A = 92 and h = 5

Since, the class intervals are inclusive type, we'll first convert it into exclusive type by extending the class interval from both the ends.

| WEIGHT(G)     | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 92$ | NUMBER OF EGGS( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|---------------|----------------------|--|-------------------------|---------------|-----------|
| 74.5 - 79.5   | 77                   | - 15                                   | 4                       | - 3           | - 12      |
| 79.5 - 84.5   | 82                   | - 10                                   | 9                       | - 2           | - 18      |
| 84.5 - 89.5   | 87                   | - 5                                    | 13                      | - 1           | - 13      |
| 89.5 - 94.5   | 92 = A               | 0                                      | 17                      | 0             | 0         |
| 94.5 - 99.5   | 97                   | 5                                      | 12                      | 1             | 12        |
| 99.5 - 104.5  | 102                  | 10                                     | 3                       | 2             | 6         |
| 104.5 - 109.5 | 107                  | 15                                     | 2                       | 3             | 6         |
| TOTAL         |                      |  | 60                      |               | - 19      |

We have got

$$A = 92, h = 5, \sum f_i = 60 \text{ & } \sum f_i u_i = - 19$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 92 - \frac{19}{60} \times 5$$

$$\Rightarrow \bar{x} = 90.42$$

Thus, mean weight is 90 g.

**Question: 29**

The following tab

**Solution:**

We will find the mean marks using step - deviation method, where A = Assumed mean and h = length of class interval.

Here, let A = 17.5 and h = 5

Since, the class intervals are less - than type, we'll first convert it into exclusive type.

| WEIGHT(G) | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 17.5$ | NUMBER OF EGGS( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|-----------|----------------------|--|-------------------------|---------------|-----------|
| 0 - 5     | 2.5                  | - 15                                     | 3                       | - 3           | - 9       |
| 5 - 10    | 7.5                  | - 10                                     | 7                       | - 2           | - 14      |
| 10 - 15   | 12.5                 | - 5                                      | 15                      | - 1           | - 15      |
| 15 - 20   | 17.5 = A             | 0  | 24                      | 0             | 0         |
| 20 - 25   | 22.5                 | 5  | 16                      | 1             | 16        |
| 25 - 30   | 27.5                 | 10                                       | 8                       | 2             | 16        |
| 30 - 35   | 32.5                 | 15                                       | 5                       | 3             | 15        |
| 35 - 40   | 37.5                 | 20                                       | 2                       | 4             | 8         |
| TOTAL     |                      |  | 80                      |               | 17        |

We have got

$$A = 17.5, h = 5, \sum f_i = 80 \text{ & } \sum f_i u_i = 17$$

$\therefore$  mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 17.5 + \frac{17}{80} \times 5$$

$$\Rightarrow \bar{x} = 18.5625$$

Thus, mean marks correct to 2 decimal places are 18.56.

## Exercise : 9B

**Question: 1**

In a hospital, th

**Solution:**

To find median,

Assume  $\sum f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| AGE(years) | NUMBER OF PATIENTS( $f_i$ ) | $C_f$            |
|------------|-----------------------------|------------------|
| 0 - 15     | 5                           | 5                |
| 15 - 30    | 20                          | $5 + 20 = 25$    |
| 30 - 45    | 40                          | $25 + 40 = 65$   |
| 45 - 60    | 50                          | $65 + 50 = 115$  |
| 60 - 75    | 25                          | $115 + 25 = 140$ |
| TOTAL      | 140                         |                  |

$$\text{So, } N = 140$$

$$\Rightarrow N/2 = 140/2 = 70$$

The cumulative frequency just greater than ( $N/2 = 70$ ) is 115, so the corresponding median class is 45 - 60 and accordingly we get  $C_f = 65$ (cumulative frequency before the median class).

Now, since median class is 45 - 60.

$$\therefore l = 45, h = 15, f = 50, N/2 = 70 \text{ and } C_f = 65$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 45 + \left( \frac{70-65}{50} \right) \times 15$$

$$= 45 + 1.5$$

$$= 46.5$$

Thus, median age is 46.5 years.

**Question: 2**

Compute the media

**Solution:**

To find median,

Assume  $\sum f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| MARKS   | NUMBER OF STUDENTS( $f_i$ ) | $C_f$          |
|---------|-----------------------------|----------------|
| 0 - 7   | 3                           | 3              |
| 7 - 14  | 4                           | $3 + 4 = 7$    |
| 14 - 21 | 7                           | $7 + 7 = 14$   |
| 21 - 28 | 11                          | $14 + 11 = 25$ |
| 28 - 35 | 0                           | $25 + 0 = 25$  |
| 35 - 42 | 16                          | $25 + 16 = 41$ |
| 42 - 49 | 9                           | $41 + 9 = 50$  |
| TOTAL   | 50                          |                |

$$\text{So, } N = 50$$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 41, so the corresponding median class is 35 - 42 and accordingly we get  $C_f = 25$  (cumulative frequency before the median class).

Now, since median class is 35 - 42.

$$\therefore l = 35, h = 7, f = 16, N/2 = 25 \text{ and } C_f = 25$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 35 + \left( \frac{25-25}{16} \right) \times 7$$

$$= 35 + 0$$

$$= 35$$

Thus, median marks are 35.

**Question: 3**

The following tab

**Solution:**

To find median,

Assume  $\Sigma f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| DAILY WAGES(Rs.) | NUMBER OF WORKERS( $f_i$ ) | $C_f$            |
|------------------|----------------------------|------------------|
| 0 - 100          | 40                         | 40               |
| 100 - 200        | 32                         | $40 + 32 = 72$   |
| 200 - 300        | 48                         | $72 + 48 = 120$  |
| 300 - 400        | 22                         | $120 + 22 = 142$ |
| 400 - 500        | 8                          | $142 + 8 = 150$  |
| TOTAL            | 150                        |                  |

So,  $N = 150$

$$\Rightarrow N/2 = 150/2 = 75$$

The cumulative frequency just greater than ( $N/2 = 75$ ) is 120, so the corresponding median class is 200 - 300 and accordingly we get  $C_f = 72$ (cumulative frequency before the median class).

Now, since median class is 200 - 300.

$$\therefore l = 200, h = 100, f = 48, N/2 = 75 \text{ and } C_f = 72$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 200 + \left( \frac{75 - 72}{48} \right) \times 100$$

$$= 200 + 6.25$$

$$= 206.25$$

Thus, median wage is Rs. 206.25.

**Question: 4**

Calculate the med

**Solution:**

To find median, Assume

$\Sigma f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table.

| CLASS   | FREQUENCY( $f_i$ ) | $C_f$          |
|---------|--------------------|----------------|
| 5 - 10  | 5                  | 5              |
| 10 - 15 | 6                  | $5 + 6 = 11$   |
| 15 - 20 | 15                 | $11 + 15 = 26$ |
| 20 - 25 | 10                 | $26 + 10 = 36$ |
| 25 - 30 | 5                  | $36 + 5 = 41$  |
| 30 - 35 | 4                  | $41 + 4 = 45$  |
| 35 - 40 | 2                  | $45 + 2 = 47$  |
| 40 - 45 | 2                  | $47 + 2 = 49$  |
| TOTAL   | 49                 |                |

So,  $N = 49$

$$\Rightarrow N/2 = 49/2 = 24.5$$

The cumulative frequency just greater than ( $N/2 = 24.5$ ) is 25, so the corresponding median class is 15 - 20 and accordingly we get  $C_f = 11$  (cumulative frequency before the median class).

Now, since median class is 15 - 20.

$$\therefore l = 15, h = 5, f = 15, N/2 = 24.5 \text{ and } C_f = 11$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 15 + \left( \frac{24.5 - 11}{15} \right) \times 5$$

$$= 15 + 4.5$$

$$= 19.5$$

Thus, median is 19.5.

**Question: 5**

Given below is th

**Solution:**

To find median, Assume

$\Sigma f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| CONSUMPTION (unit) | NUMBER OF CONSUMERS( $f_i$ ) | $C_f$          |
|--------------------|------------------------------|----------------|
| 65 - 85            | 4                            | 4              |
| 85 - 105           | 5                            | $4 + 5 = 9$    |
| 105 - 125          | 13                           | $9 + 13 = 22$  |
| 125 - 145          | 20                           | $22 + 20 = 42$ |
| 145 - 165          | 14                           | $42 + 14 = 56$ |
| 165 - 185          | 7                            | $56 + 7 = 63$  |
| 185 - 205          | 4                            | $63 + 4 = 67$  |
| TOTAL              | 67                           |                |

So,  $N = 67$

$$\Rightarrow N/2 = 67/2 = 33.5$$

The cumulative frequency just greater than ( $N/2 = 33.5$ ) is 42, so the corresponding median class is 125 - 145 and accordingly we get  $C_f = 22$ (cumulative frequency before the median class).

Now, since median class is 125 - 145.

$\therefore l = 125$ ,  $h = 20$ ,  $f = 20$ ,  $N/2 = 33.5$  and  $C_f = 22$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$
$$\Rightarrow \text{Median} = 125 + \left( \frac{33.5 - 22}{20} \right) \times 20$$
$$= 125 + 11.5$$
$$= 136.5$$

Thus, median is 136.5.

**Question: 6**

Calculate the med

**Solution:**

To find median, Assume

$\sum f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table.

| HEIGHT(cm) | NUMBER OF BOYS( $f_i$ ) | $C_f$          |
|------------|-------------------------|----------------|
| 135 - 140  | 6                       | 6              |
| 140 - 145  | 10                      | $6 + 10 = 16$  |
| 145 - 150  | 18                      | $16 + 18 = 34$ |
| 150 - 155  | 22                      | $34 + 22 = 56$ |
| 155 - 160  | 20                      | $56 + 20 = 76$ |
| 160 - 165  | 15                      | $76 + 15 = 91$ |
| 165 - 170  | 6                       | $91 + 6 = 97$  |
| 170 - 175  | 3                       | $97 + 3 = 100$ |
| TOTAL      | 100                     |                |

So,  $N = 100$

$$\Rightarrow N/2 = 100/2 = 50$$

The cumulative frequency just greater than ( $N/2 = 50$ ) is 56, so the corresponding median class is 150 - 155 and accordingly we get  $C_f = 34$  (cumulative frequency before the median class).

Now, since median class is 150 - 155.

$$\therefore l = 150, h = 5, f = 22, N/2 = 50 \text{ and } C_f = 34$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 150 + \left( \frac{50-34}{22} \right) \times 5$$

$$= 150 + 3.636$$

$$= 153.64$$

Thus, median is 153.64 cm.

**Question: 7**

Calculate the mis

**Solution:**

Median(given) = 24, Assume

$\sum f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table, where  $x$  is the unknown frequency.

| CLASS   | FREQUENCY( $f_i$ ) | $C_f$                  |
|---------|--------------------|------------------------|
| 0 - 10  | 5                  | 5                      |
| 10 - 20 | 25                 | $5 + 25 = 30$          |
| 20 - 30 | $x$                | $30 + x$               |
| 30 - 40 | 18                 | $30 + x + 18 = 48 + x$ |
| 40 - 50 | 7                  | $48 + x + 7 = 55 + x$  |
| TOTAL   | $55 + x$           |                        |

Median = 24 (as already mentioned in the question)

24 lies between 20 - 30  $\Rightarrow$  Median class = 20 - 30

$\therefore l = 20, h = 10, f = x, N/2 = (55 + x)/2$  and  $C_f = 30$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow 24 = 20 + \left( \frac{\frac{55+x}{2} - 30}{x} \right) \times 10$$

$$\Rightarrow 24 = 20 + \left( \frac{55+x-60}{2x} \right) \times 10$$

$$\Rightarrow 24 - 20 = (10x - 50)/2x$$

$$\Rightarrow (4)(2x) = 10x - 50$$

$$\Rightarrow 8x = 10x - 50$$

$$\Rightarrow 10x - 8x = 50$$

$$\Rightarrow 2x = 50$$

$$\Rightarrow x = 25$$

Thus, the unknown frequency is 25.

**Question: 8**

The median of the

**Solution:**

Given: Median = 16 & N = 70

Assume

$\Sigma f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table, where  $x$  is the unknown frequency.

| CLASS   | FREQUENCY( $f_i$ ) | $C_f$                         |
|---------|--------------------|-------------------------------|
| 0 - 5   | 12                 | 12                            |
| 5 - 10  | a                  | $12 + a$                      |
| 10 - 15 | 12                 | $12 + a + 12 = 24 + a$        |
| 15 - 20 | 15                 | $24 + a + 15 = 39 + a$        |
| 20 - 25 | b                  | $39 + a + b$                  |
| 25 - 30 | 6                  | $39 + a + b + 6 = 45 + a + b$ |
| 30 - 35 | 6                  | $45 + a + b + 6 = 51 + a + b$ |
| 35 - 40 | 4                  | $51 + a + b + 4 = 55 + a + b$ |
| TOTAL   | $55 + a + b$       |                               |

Median = 16 (as already mentioned in the question)

16 lies between 15 - 20  $\Rightarrow$  Median class = 15 - 20

$\therefore l = 15, h = 5, f = 15, N/2 = (55 + a + b)/2$  and  $C_f = 24 + a$

Median is given by,

$$\begin{aligned}
 \text{Median} &= l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h \\
 \Rightarrow 16 &= 15 + \left( \frac{\frac{55+a+b}{2} - (24+a)}{15} \right) \times 5 \\
 \Rightarrow 16 &= 15 + \left( \frac{55+a+b-48-2a}{30} \right) \times 5 \\
 \Rightarrow 16 - 15 &= (7 - a + b)/6 \\
 \Rightarrow 6 &= 7 - a + b
 \end{aligned}$$

$$\Rightarrow a - b = 1 \dots(i)$$

And given that  $N = 70$

$$\Rightarrow 55 + a + b = 70$$

$$\Rightarrow a + b = 15 \dots(ii)$$

Solving equations (i) & (ii), we get

$$(a - b) + (a + b) = 1 + 15$$

$$\Rightarrow 2a = 16$$

$$\Rightarrow a = 8$$

Substituting  $a = 8$  in eq.(i),

$$8 - b = 1$$

$$\Rightarrow b = 7$$

Thus, the unknown frequencies are  $a = 8$  and  $b = 7$ .

### Question: 9

In the following

#### Solution:

Given: Median = 5000 &  $N = 60$

Assume

$\Sigma f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table, where  $x$  is the unknown frequency.

| RUNS SCORED | NUMBER OF BATSMEN( $f_i$ ) | $C_f$                         |
|-------------|----------------------------|-------------------------------|
| 2500 - 3500 | 5                          | 5                             |
| 3500 - 4500 | $x$                        | $5 + x$                       |
| 4500 - 5500 | $y$                        | $5 + x + y$                   |
| 5500 - 6500 | 12                         | $5 + x + y + 12 = 17 + x + y$ |
| 6500 - 7500 | 6                          | $17 + x + y + 6 = 23 + x + y$ |
| 7500 - 8500 | 2                          | $23 + x + y + 2 = 25 + x + y$ |
| TOTAL       | $25 + x + y$               |                               |

Given, Median = 5000 (as already mentioned in the question)

Sum of frequencies,  $N = x + y + 25 = 60$  [Total No of players]

5000 lies between 4500 - 5500  $\Rightarrow$  Median class = 4500 - 5500

$\therefore l = 4500, h = 1000, f = y, N/2 = 60/2=30$  and  $C_f = 5 + x$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$
$$\Rightarrow 5000 = 4500 + \left( \frac{\frac{60}{2} - (5 + x)}{y} \right) \times 1000$$
$$\Rightarrow 5000 = 4500 + \left( \frac{30 - 5 - x}{y} \right) \times 1000$$

$$\Rightarrow 5000 - 4500 = (25000 - 1000x)/y$$

$$\Rightarrow 500y = 25000 - 1000x$$

$$\Rightarrow 2x + y = 50 \dots(\text{i})$$

And given that  $N = 60$

$$\Rightarrow 25 + x + y = 60$$

$$\Rightarrow x + y = 35 \dots(\text{ii})$$

Solving equations (i) & (ii), we get

$$(2x + y) - (x + y) = 50 - 35$$

$$\Rightarrow x = 15$$

Substituting  $x = 15$  in eq.(ii),

$$15 + y = 35$$

$$\Rightarrow y = 20$$

Thus, the unknown frequencies are  $x = 15$  and  $y = 20$ .

### Question: 10

If the median of

#### Solution:

Given: Median = 32.5 &  $N = 40$

Assume

$\Sigma f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table, where  $x$  is the unknown frequency.

| CLASS   | NUMBER OF BATSMEN( $f_i$ ) | $C_f$                                 |
|---------|----------------------------|---------------------------------------|
| 0 - 10  | $f_1$                      | $f_1$                                 |
| 10 - 20 | 5                          | $5 + f_1$                             |
| 20 - 30 | 9                          | $5 + f_1 + 9 = 14 + f_1$              |
| 30 - 40 | 12                         | $14 + f_1 + 12 = 26 + f_1$            |
| 40 - 50 | $f_2$                      | $26 + f_1 + f_2$                      |
| 50 - 60 | 3                          | $26 + f_1 + f_2 + 3 = 29 + f_1 + f_2$ |
| 60 - 70 | 2                          | $29 + f_1 + f_2 + 2 = 31 + f_1 + f_2$ |
| TOTAL   | $31 + f_1 + f_2$           |                                       |

Median = 32.5 (as already mentioned in the question)

32.5 lies between 30 - 40  $\Rightarrow$  Median class = 30 - 40

$\therefore l = 30, h = 10, f = 12, N/2 = (31 + f_1 + f_2)/2 = 40/2$  and  $C_f = 14 + f_1$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow 32.5 = 30 + \left( \frac{\frac{40}{2} - (14 + f_1)}{12} \right) \times 10$$

$$\Rightarrow 32.5 = 30 + \left( \frac{20 - 14 - f_1}{12} \right) \times 10$$

$$\Rightarrow 32.5 - 30 = (60 - 10f_1)/12$$

$$\Rightarrow (2.5)(12) = 60 - 10f_1$$

$$\Rightarrow 30 = 60 - 10f_1$$

$$\Rightarrow f_1 = 3 \dots(i)$$

And given that  $N = 40$

$$\Rightarrow 31 + f_1 + f_2 = 40$$

$$\Rightarrow f_1 + f_2 = 9 \dots \text{(ii)}$$

Substituting  $f_1 = 3$  in eq.(ii),

$$3 + f_2 = 9$$

$$\Rightarrow f_2 = 6$$

Thus, the unknown frequencies are  $f_1 = 3$  and  $f_2 = 6$ .

### Question: 11

Calculate the med

#### Solution:

To find median, Assume

$$\sum f_i = N = \text{Sum of frequencies},$$

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table and convert it into exclusive - type by adjusting from both ends of a class.

| AGE(years)  | FREQUENCY( $f_i$ ) | $C_f$             |
|-------------|--------------------|-------------------|
| 18.5 - 25.5 | 35                 | 35                |
| 25.5 - 32.5 | 96                 | $35 + 96 = 131$   |
| 32.5 - 39.5 | 68                 | $131 + 68 = 199$  |
| 39.5 - 46.5 | 102                | $199 + 102 = 301$ |
| 46.5 - 53.5 | 35                 | $301 + 35 = 336$  |
| 53.5 - 60.5 | 4                  | $336 + 4 = 340$   |
| TOTAL       | 340                |                   |

So,  $N = 340$

$$\Rightarrow N/2 = 340/2 = 170$$

The cumulative frequency just greater than ( $N/2 = 170$ ) is 199, so the corresponding median class is 32.5 - 39.5 and accordingly we get  $C_f = 131$  (cumulative frequency before the median class).

Now, since median class is 32.5 - 39.5.

$$\therefore l = 32.5, h = 7, f = 68, N/2 = 170 \text{ and } C_f = 131$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 32.5 + \left( \frac{170 - 131}{68} \right) \times 7$$

$$= 32.5 + 4.014$$

$$= 36.51$$

Thus, median is 36.51 years.

### Question: 12

Find the median w

#### Solution:

To find median, Assume

$\sum f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table and convert it into exclusive - type by adjusting from both ends of a class.

| WAGES PER DAY(Rs.) | NUMBER OF WOMEN WORKERS( $f_i$ ) | $C_f$          |
|--------------------|----------------------------------|----------------|
| 60.5 - 70.5        | 5                                | 5              |
| 70.5 - 80.5        | 15                               | $5 + 15 = 20$  |
| 80.5 - 90.5        | 20                               | $20 + 20 = 40$ |
| 90.5 - 100.5       | 30                               | $40 + 30 = 70$ |
| 100.5 - 110.5      | 20                               | $70 + 20 = 90$ |
| 110.5 - 120.5      | 8                                | $90 + 8 = 98$  |
| TOTAL              | 98                               |                |

So,  $N = 98$

$$\Rightarrow N/2 = 98/2 = 49$$

The cumulative frequency just greater than ( $N/2 = 49$ ) is 70, so the corresponding median class is 90.5 - 100.5 and accordingly we get  $C_f = 40$  (cumulative frequency before the median class).

Now, since median class is 90.5 - 100.5.

$$\therefore l = 90.5, h = 10, f = 30, N/2 = 49 \text{ and } C_f = 40$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 90.5 + \left( \frac{49-40}{30} \right) \times 10$$

$$= 90.5 + 3$$

$$= 93.5$$

Thus, median is Rs. 93.5.

### Question: 13

Find the median f

### Solution:

To find median, Assume

$\Sigma f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table and convert it into exclusive - type by adjusting from both ends of a class.

| CLASS       | FREQUENCY( $f_i$ ) | $C_f$            |
|-------------|--------------------|------------------|
| 0.5 - 5.5   | 7                  | 7                |
| 5.5 - 10.5  | 10                 | $7 + 10 = 17$    |
| 10.5 - 15.5 | 16                 | $17 + 16 = 33$   |
| 15.5 - 20.5 | 32                 | $33 + 32 = 65$   |
| 20.5 - 25.5 | 24                 | $65 + 24 = 89$   |
| 25.5 - 30.5 | 16                 | $89 + 16 = 105$  |
| 30.5 - 35.5 | 11                 | $105 + 11 = 116$ |
| 35.5 - 40.5 | 5                  | $116 + 5 = 121$  |
| 40.5 - 45.5 | 2                  | $121 + 2 = 123$  |
| TOTAL       | 123                |                  |

So,  $N = 123$

$$\Rightarrow N/2 = 123/2 = 61.5$$

The cumulative frequency just greater than ( $N/2 = 61.5$ ) is 65, so the corresponding median class is 15.5 - 20.5 and accordingly we get  $C_f = 33$ (cumulative frequency before the median class).

Now, since median class is 15.5 - 20.5.

$\therefore l = 15.5$ ,  $h = 5$ ,  $f = 32$ ,  $N/2 = 61.5$  and  $C_f = 33$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$
$$\Rightarrow \text{Median} = 15.5 + \left( \frac{61.5 - 33}{32} \right) \times 5$$
$$= 15.5 + 4.45$$
$$= 19.95$$

Thus, median is 19.95.

**Question: 14**

Find the median f

**Solution:**

To find median, Assume

$\Sigma f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table and convert it into exclusive - type.

| MARKS   | $C_f$ | NUMBER OF STUDENTS( $f_i$ ) |
|---------|-------|-----------------------------|
| 0 - 10  | 12    | 12                          |
| 10 - 20 | 32    | $32 - 12 = 20$              |
| 20 - 30 | 57    | $57 - 32 = 25$              |
| 30 - 40 | 80    | $80 - 57 = 23$              |
| 40 - 50 | 92    | $92 - 80 = 12$              |
| 50 - 60 | 116   | $116 - 92 = 24$             |
| 60 - 70 | 164   | $164 - 116 = 48$            |
| 70 - 80 | 200   | $200 - 164 = 36$            |
| TOTAL   |       | 200                         |

So,  $N = 200$

$$\Rightarrow N/2 = 200/2 = 100$$

The cumulative frequency just greater than ( $N/2 = 100$ ) is 116, so the corresponding median class is 50 - 60 and accordingly we get  $C_f = 92$ (cumulative frequency before the median class).

Now, since median class is 50 - 60.

$$\therefore l = 50, h = 10, f = 24, N/2 = 100 \text{ and } C_f = 92$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 50 + \left( \frac{100 - 92}{24} \right) \times 10$$

$$= 50 + 3.33$$

$$= 53.33$$

Thus, median is 53.33.

## Exercise : 9C

### Question: 1

Find the mode of

#### Solution:

Here, the maximum class frequency is 45.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 30 - 40

$\therefore$  lower limit of the modal class (l) = 30

Modal class size (h) = 10

Frequency of the modal class ( $f_1$ ) = 45

Frequency of class preceding the modal class ( $f_0$ ) = 35

Frequency of class succeeding the modal ( $f_2$ ) = 25

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 30 + \left( \frac{45-35}{2(45)-35-25} \right) \times 10$$

$$\Rightarrow \text{Mode} = 30 + \left( \frac{10}{30} \right) \times 10$$

$$\Rightarrow \text{Mode} = 30 + 3.33 = 33.33$$

Hence, the mode is 33.33

### Question: 2

Compute the mode

#### Solution:

Here, the maximum class frequency is 28.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 40 - 60

$\therefore$  lower limit of the modal class (l) = 40

Modal class size (h) = 20

Frequency of the modal class ( $f_1$ ) = 28

Frequency of class preceding the modal class ( $f_0$ ) = 16

Frequency of class succeeding the modal ( $f_2$ ) = 20

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 40 + \left( \frac{28-16}{2(28)-16-20} \right) \times 20$$

$$\Rightarrow \text{Mode} = 40 + \left( \frac{12}{20} \right) \times 20$$

$$\Rightarrow \text{Mode} = 40 + 12 = 52$$

Hence, the mode is 52.

**Question: 3**

Heights of students

**Solution:**

Here, the maximum class frequency is 20.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 160 - 165

$\therefore$  lower limit of the modal class ( $l$ ) = 160

Modal class size ( $h$ ) = 5

Frequency of the modal class ( $f_1$ ) = 20

Frequency of class preceding the modal class ( $f_0$ ) = 8

Frequency of class succeeding the modal class ( $f_2$ ) = 12

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 160 + \left( \frac{20-8}{2(20)-8-12} \right) \times 5$$

$$\Rightarrow \text{Mode} = 160 + \left( \frac{12}{20} \right) \times 5$$

$$\Rightarrow \text{Mode} = 160 + 3 = 163$$

Hence, the mode is 163 cm.

Mode represents frequency, hence 163 cm is the height of maximum number of students.

To find the mean, we will solve by using direct method.

| HEIGHT (cm) | MID - POINT( $x_i$ ) | NUMBER OF STUDENTS( $f_i$ ) | $f_i x_i$ |
|-------------|----------------------|-----------------------------|-----------|
| 150 - 155   | 152.5                | 15                          | 2287.5    |
| 155 - 160   | 157.5                | 8                           | 1260      |
| 160 - 165   | 162.5                | 20                          | 3250      |
| 165 - 170   | 167.5                | 12                          | 2010      |
| 170 - 175   | 172.5                | 5                           | 862.5     |
| TOTAL       |                      | 60                          | 9670      |

We have got

$$\sum f_i = 60 \text{ & } \sum f_i x_i = 9670$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{9670}{60}$$

$$\Rightarrow \bar{x} = 161.17$$

Thus, mean is 161.17

Mean represents average, thus 161.7 cm is the average height of all the students.

**Question: 4**

Find the mode of

**Solution:**

Here, the maximum class frequency is 25.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 26 - 30

$\therefore$  lower limit of the modal class (l) = 26

Modal class size (h) = 4

Frequency of the modal class ( $f_1$ ) = 25

Frequency of class preceding the modal class ( $f_0$ ) = 20

Frequency of class succeeding the modal ( $f_2$ ) = 22

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 26 + \left( \frac{25-20}{2(25)-20-22} \right) \times 4$$

$$\Rightarrow \text{Mode} = 26 + \left( \frac{5}{8} \right) \times 4$$

$$\Rightarrow \text{Mode} = 26 + 2.5 = 28.5$$

Hence, the mode is 28.5.

**Question: 5**

Given below is th

**Solution:**

Expenditure done by maximum number of manual workers is estimated by finding mode.

So here, the maximum class frequency is 40.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 1500 - 2000

$\therefore$  lower limit of the modal class (l) = 1500

Modal class size (h) = 500

Frequency of the modal class ( $f_1$ ) = 40

Frequency of class preceding the modal class ( $f_0$ ) = 24

Frequency of class succeeding the modal ( $f_2$ ) = 31

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 1500 + \left( \frac{40-24}{2(40)-24-31} \right) \times 500$$

$$\Rightarrow \text{Mode} = 1500 + \left( \frac{16}{25} \right) \times 500$$

$$\Rightarrow \text{Mode} = 1500 + 320 = 1820$$

Hence, the mode is Rs.1820.

**Question: 6**

Calculate the mod

**Solution:**

Here, the maximum class frequency is 150.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 5000 - 10000

$\therefore$  lower limit of the modal class (l) = 5000

Modal class size (h) = 5000

Frequency of the modal class ( $f_1$ ) = 150

Frequency of class preceding the modal class ( $f_0$ ) = 90

Frequency of class succeeding the modal class ( $f_2$ ) = 100

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 5000 + \left( \frac{150-90}{2(150)-90-100} \right) \times 5000$$

$$\Rightarrow \text{Mode} = 5000 + \left( \frac{60}{110} \right) \times 5000$$

$$\Rightarrow \text{Mode} = 5000 + 2727.27 = 7727.27$$

Hence, the mode is Rs.7727.27.

**Question: 7**

Compute the mode

**Solution:**

Here, the maximum class frequency is 24.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 15 - 20

$\therefore$  lower limit of the modal class (l) = 15

Modal class size (h) = 5

Frequency of the modal class ( $f_1$ ) = 24

Frequency of class preceding the modal class ( $f_0$ ) = 18

Frequency of class succeeding the modal class ( $f_2$ ) = 17

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 15 + \left( \frac{24-18}{2(24)-18-17} \right) \times 5$$

$$\Rightarrow \text{Mode} = 15 + \left( \frac{6}{13} \right) \times 5$$

$$\Rightarrow \text{Mode} = 15 + 2.30 = 17.30$$

Hence, the mode is 17.30 years.

### Question: 8

Compute the mode

#### Solution:

Here, the maximum class frequency is 32.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 85 - 95

$\therefore$  lower limit of the modal class (l) = 85

Modal class size (h) = 10

Frequency of the modal class ( $f_1$ ) = 32

Frequency of class preceding the modal class ( $f_0$ ) = 30

Frequency of class succeeding the modal class ( $f_2$ ) = 6

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 85 + \left( \frac{32-30}{2(32)-30-6} \right) \times 10$$

$$\Rightarrow \text{Mode} = 85 + \left( \frac{2}{28} \right) \times 10$$

$$\Rightarrow \text{Mode} = 85 + 0.71 = 85.71$$

Hence, the mode is 85.71.

### Question: 9

Compute the mode

#### Solution:

Since, the given data is in inclusive series, it needs to get converted in exclusive series.

| CLASS INTERVAL | 0.5 - 5.5 | 5.5 - 10.5 | 10.5 - 15.5 | 15.5 - 20.5 | 20.5 - 25.5 | 25.5 - 30.5 | 30.5 - 35.5 | 35.5 - 40.5 | 40.5 - 45.5 | 45.5 - 50.5 |
|----------------|-----------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| FREQUENCY      | 3         | 8          | 13          | 18          | 28          | 20          | 13          | 8           | 6           | 4           |

Here, the maximum class frequency is 28.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 15.5 - 20.5

$\therefore$  lower limit of the modal class (l) = 15.5

Modal class size (h) = 5

Frequency of the modal class ( $f_1$ ) = 28

Frequency of class preceding the modal class ( $f_0$ ) = 18

Frequency of class succeeding the modal ( $f_2$ ) = 20

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 15.5 + \left( \frac{28-18}{2(28)-18-20} \right) \times 5$$

$$\Rightarrow \text{Mode} = 15.5 + \left( \frac{10}{18} \right) \times 5$$

$$\Rightarrow \text{Mode} = 15.5 + 2.78 = 23.28$$

Hence, the mode is 23.28.

### Question: 10

The agewise parti

#### Solution:

To find frequencies, we have Sum of frequencies that is, 181.

Using Sum of frequencies = 181,

$$x + 15 + 18 + 30 + 50 + 48 + x = 181$$

$$\Rightarrow 2x + 161 = 181$$

$$\Rightarrow 2x = 181 - 161 = 20$$

$$\Rightarrow x = 10$$

Thus we have,

| Age (in years)     | 5 - 7 | 7 - 9 | 9 - 11 | 11 - 13 | 13 - 15 | 15 - 17 | 17 - 19 |
|--------------------|-------|-------|--------|---------|---------|---------|---------|
| Number of students | 10    | 15    | 18     | 30      | 50      | 48      | 10      |

Here, the maximum class frequency is 50.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 13 - 15

$\therefore$  lower limit of the modal class (l) = 13

Modal class size (h) = 2

Frequency of the modal class ( $f_1$ ) = 50

Frequency of class preceding the modal class ( $f_0$ ) = 30

Frequency of class succeeding the modal ( $f_2$ ) = 48

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 13 + \left( \frac{50-30}{2(50)-30-48} \right) \times 2$$

$$\Rightarrow \text{Mode} = 13 + \left( \frac{20}{22} \right) \times 2$$

$$\Rightarrow \text{Mode} = 13 + 1.82 = 14.82$$

Hence, the mode is 14.82.

## Exercise : 9D

### Question: 1

Find the mean, mo

### Solution:

To find mean, we will solve by direct method:

| CLASS INTERVAL | MID - POINT( $x_i$ ) | NUMBER OF BATSMEN( $f_i$ ) | $f_i x_i$ |
|----------------|----------------------|----------------------------|-----------|
| 0 - 10         | 5                    | 4                          | 20        |
| 10 - 20        | 15                   | 4                          | 60        |
| 20 - 30        | 25                   | 7                          | 175       |
| 30 - 40        | 35                   | 10                         | 350       |
| 40 - 50        | 45                   | 12                         | 540       |
| 50 - 60        | 55                   | 8                          | 440       |
| 60 - 70        | 65                   | 5                          | 325       |
| TOTAL          |                      | 50                         | 1910      |

We have got

$$\sum f_i = 50 \text{ & } \sum f_i x_i = 1910$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{1910}{50}$$

$$\Rightarrow \bar{x} = 38.2$$

To find median,

Assume  $\sum f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| CLASS INTERVAL | NUMBER OF WORKERS( $f_i$ ) | $C_f$          |
|----------------|----------------------------|----------------|
| 0 - 10         | 4                          | 4              |
| 10 - 20        | 4                          | $4 + 4 = 8$    |
| 20 - 30        | 7                          | $8 + 7 = 15$   |
| 30 - 40        | 10                         | $15 + 10 = 25$ |
| 40 - 50        | 12                         | $25 + 12 = 37$ |
| 50 - 60        | 8                          | $37 + 8 = 45$  |
| 60 - 70        | 5                          | $45 + 5 = 50$  |
| TOTAL          | 50                         |                |

So,  $N = 50$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 37, so the corresponding median class is 40 - 50 and accordingly we get  $C_f = 25$  (cumulative frequency before the median class).

Now, since median class is 40 - 50.

$$\therefore l = 40, h = 10, f = 16, N/2 = 25 \text{ and } C_f = 25$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 40 + \left( \frac{25 - 25}{16} \right) 10$$

$$= 40 + 0$$

$$= 40$$

And we know that,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$= 3(40) - 2(38.2)$$

$$= 120 - 76.4$$

$$= 43.6$$

Hence, mean is 38.2, median is 40 and mode is 43.6.

### Question: 2

Find the mean, me

### Solution:

To find mean, we will solve by direct method:

| CLASS     | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|-----------|----------------------|--------------------|-----------|
| 0 - 20    | 10                   | 6                  | 60        |
| 20 - 40   | 30                   | 8                  | 240       |
| 40 - 60   | 50                   | 10                 | 500       |
| 60 - 80   | 70                   | 12                 | 840       |
| 80 - 100  | 90                   | 6                  | 540       |
| 100 - 120 | 110                  | 5                  | 550       |
| 120 - 140 | 130                  | 3                  | 390       |
| TOTAL     |                      | 50                 | 3120      |

We have got

$$\sum f_i = 50 \text{ & } \sum f_i x_i = 3120$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{3120}{50}$$

$$\Rightarrow \bar{x} = 62.4$$

To find median,

Assume  $\sum f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| CLASS     | FREQUENCY( $f_i$ ) | $C_f$          |
|-----------|--------------------|----------------|
| 0 - 20    | 6                  | 6              |
| 20 - 40   | 8                  | $6 + 8 = 14$   |
| 40 - 60   | 10                 | $14 + 10 = 24$ |
| 60 - 80   | 12                 | $24 + 12 = 36$ |
| 80 - 100  | 6                  | $36 + 6 = 42$  |
| 100 - 120 | 5                  | $42 + 5 = 47$  |
| 120 - 140 | 3                  | $47 + 3 = 50$  |
| TOTAL     | 50                 |                |

So,  $N = 50$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 36, so the corresponding median class is 60 - 80 and accordingly we get  $C_f = 24$  (cumulative frequency before the median class).

Now, since median class is 60 - 80.

$$\therefore l = 60, h = 20, f = 12, N/2 = 25 \text{ and } C_f = 24$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 60 + \left( \frac{25-24}{12} \right) \times 20$$

$$= 60 + 1.67$$

$$= 61.67$$

And we know that,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$= 3(61.67) - 2(62.4)$$

$$= 185.01 - 124.8$$

$$= 60.21$$

Hence, mean is 62.4, median is 61.67 and mode is 60.21.

**Question: 3**

Find the mean, me

**Solution:**

To find mean, we will solve by direct method:

| CLASS     | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|-----------|----------------------|--------------------|-----------|
| 0 - 50    | 25                   | 2                  | 50        |
| 50 - 100  | 75                   | 3                  | 225       |
| 100 - 150 | 125                  | 5                  | 625       |
| 150 - 200 | 175                  | 6                  | 1050      |
| 200 - 250 | 225                  | 5                  | 1125      |
| 250 - 300 | 275                  | 3                  | 825       |
| 300 - 350 | 325                  | 1                  | 325       |
| TOTAL     |                      | 25                 | 4225      |

We have got

$$\sum f_i = 25 \text{ & } \sum f_i x_i = 4171$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{4225}{25}$$

$$\Rightarrow \bar{x} = 169$$

To find median,

Assume  $\sum f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table.

| CLASS     | FREQUENCY( $f_i$ ) | $C_f$         |
|-----------|--------------------|---------------|
| 0 - 50    | 2                  | 2             |
| 50 - 100  | 3                  | $2 + 3 = 5$   |
| 100 - 150 | 5                  | $5 + 5 = 10$  |
| 150 - 200 | 6                  | $10 + 6 = 16$ |
| 200 - 250 | 5                  | $16 + 5 = 21$ |
| 250 - 300 | 3                  | $21 + 3 = 24$ |
| 300 - 350 | 1                  | $24 + 1 = 25$ |
| TOTAL     | 25                 |               |

So,  $N = 25$

$$\Rightarrow N/2 = 25/2 = 12.5$$

The cumulative frequency just greater than ( $N/2 = 12.5$ ) is 16, so the corresponding median class is 150 - 200 and accordingly we get  $C_f = 10$  (cumulative frequency before the median class).

Now, since median class is 150 - 200.

$$\therefore l = 150, h = 50, f = 6, N/2 = 12.5 \text{ and } C_f = 10$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 150 + \left( \frac{12.5 - 10}{6} \right) \times 50$$

$$= 150 + 20.83$$

$$= 170.83$$

And we know that,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$= 3(170.83) - 2(169)$$

$$= 512.49 - 338$$

$$= 174.49$$

Hence, mean is 169, median is 170.83 and mode is 174.49.

#### **Question: 4**

Find the mode, me

#### **Solution:**

To find mean, we will solve by direct method:

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|---------|----------------------|--------------------|-----------|
| 25 - 35 | 30                   | 7                  | 210       |
| 35 - 45 | 40                   | 31                 | 1240      |
| 45 - 55 | 50                   | 33                 | 1650      |
| 55 - 65 | 60                   | 17                 | 1020      |
| 65 - 75 | 70                   | 11                 | 770       |
| 75 - 85 | 80                   | 1                  | 80        |
| TOTAL   |                      | 100                | 4970      |

We have got

$$\sum f_i = 100 \text{ & } \sum f_i x_i = 4970$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{4970}{100}$$

$$\Rightarrow \bar{x} = 49.7$$

To find median,

Assume  $\Sigma f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| CLASS   | FREQUENCY( $f_i$ ) | $C_f$          |
|---------|--------------------|----------------|
| 25 - 35 | 7                  | 7              |
| 35 - 45 | 31                 | $7 + 31 = 38$  |
| 45 - 55 | 33                 | $38 + 33 = 71$ |
| 55 - 65 | 17                 | $71 + 17 = 88$ |
| 65 - 75 | 11                 | $88 + 11 = 99$ |
| 75 - 85 | 1                  | $99 + 1 = 100$ |
| TOTAL   | 100                |                |

So,  $N = 100$

$$\Rightarrow N/2 = 100/2 = 50$$

The cumulative frequency just greater than ( $N/2 = 50$ ) is 71, so the corresponding median class is 45 - 55 and accordingly we get  $C_f = 38$ (cumulative frequency before the median class).

Now, since median class is 45 - 55.

$\therefore l = 45, h = 10, f = 33, N/2 = 50$  and  $C_f = 38$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 45 + \left( \frac{\frac{50-38}{2}}{33} \right) \times 10$$

$$= 45 + 3.64$$

$$= 48.64$$

And we know that,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$= 3(48.64) - 2(49.7)$$

$$= 145.92 - 99.4$$

$$= 46.52$$

Hence, mean is 49.7, median is 48.64 and mode is 46.52.

**Question: 5**

A survey regarding

**Solution:**

To find mean, we will solve by direct method:

| HEIGHT (cm.) | MID - POINT( $x_i$ ) | TOTAL NUMBER OF GIRLS( $f_i$ ) | $f_i x_i$ |
|--------------|----------------------|--------------------------------|-----------|
| 120 - 130    | 125                  | 2                              | 250       |
| 130 - 140    | 135                  | 8                              | 1080      |
| 140 - 150    | 145                  | 12                             | 1740      |
| 150 - 160    | 155                  | 20                             | 3100      |
| 160 - 170    | 165                  | 8                              | 1320      |
| TOTAL        |                      | 50                             | 7490      |

We have got

$$\sum f_i = 50 \text{ & } \sum f_i x_i = 7490$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{7490}{50}$$

$$\Rightarrow \bar{x} = 149.8$$

To find median,

Assume  $\sum f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| HEIGHT (cm.) | TOTAL NUMBER OF GIRLS( $f_i$ ) | $C_f$          |
|--------------|--------------------------------|----------------|
| 120 - 130    | 2                              | 2              |
| 130 - 140    | 8                              | $2 + 8 = 10$   |
| 140 - 150    | 12                             | $10 + 12 = 22$ |
| 150 - 160    | 20                             | $22 + 20 = 42$ |
| 160 - 170    | 8                              | $42 + 8 = 50$  |
| TOTAL        | 50                             |                |

So,  $N = 50$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 42, so the corresponding median class is 150 - 160 and accordingly we get  $C_f = 22$ (cumulative frequency before the median class).

Now, since median class is 150 - 160.

$$\therefore l = 150, h = 10, f = 20, N/2 = 25 \text{ and } C_f = 22$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 150 + \left( \frac{25-22}{20} \right) \times 10$$

$$= 150 + 1.5$$

$$= 151.5$$

And we know that,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$= 3(151.5) - 2(149.8)$$

$$= 454.5 - 299.6$$

$$= 154.9$$

Hence, mean is 149.8, median is 151.5 and mode is 154.9.

### Question: 6

The following tab

#### Solution:

To find mean, we will solve by direct method:

| DAILY INCOME (Rs.) | MID - POINT( $x_i$ ) | NUMBER OF WORKERS( $f_i$ ) | $f_i x_i$ |
|--------------------|----------------------|----------------------------|-----------|
| 100 - 120          | 110                  | 12                         | 1320      |
| 120 - 140          | 130                  | 14                         | 1820      |
| 140 - 160          | 150                  | 8                          | 1200      |
| 160 - 180          | 170                  | 6                          | 1020      |
| 180 - 200          | 190                  | 10                         | 1900      |
| TOTAL              |                      | 50                         | 7260      |

We have got

$$\sum f_i = 50 \text{ & } \sum f_i x_i = 7260$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow \bar{x} = \frac{7260}{50}$$

$$\Rightarrow \bar{x} = 145.2$$

To find median,

Assume  $\sum f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| DAILY INCOME (Rs.) | NUMBER OF WORKERS( $f_i$ ) | $C_f$          |
|--------------------|----------------------------|----------------|
| 100 - 120          | 12                         | 12             |
| 120 - 140          | 14                         | $12 + 14 = 26$ |
| 140 - 160          | 8                          | $26 + 8 = 34$  |
| 160 - 180          | 6                          | $34 + 6 = 40$  |
| 180 - 200          | 10                         | $40 + 10 = 50$ |
| TOTAL              | 50                         |                |

So,  $N = 50$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 26, so the corresponding median class is 120 - 140 and accordingly we get  $C_f = 12$ (cumulative frequency before the median class).

Now, since median class is 120 - 140.

$$\therefore l = 120, h = 20, f = 14, N/2 = 25 \text{ and } C_f = 12$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 120 + \left( \frac{25-12}{14} \right) \times 20$$

$$= 120 + 18.57$$

$$= 138.57$$

And we know that,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$= 3(138.57) - 2(145.2)$$

$$= 415.71 - 290.4$$

$$= 125.31$$

Hence, mean is 145.2, median is 138.57 and mode is 125.31.

### Question: 7

The table below shows

#### Solution:

To find mean, we will solve by direct method:

| DAILY EXPENDITURE (Rs.) | MID - POINT( $x_i$ ) | NUMBER OF HOUSEHOLDS( $f_i$ ) | $f_i x_i$ |
|-------------------------|----------------------|-------------------------------|-----------|
| 100 - 150               | 125                  | 6                             | 750       |
| 150 - 200               | 175                  | 7                             | 1225      |
| 200 - 250               | 225                  | 12                            | 2700      |
| 250 - 300               | 275                  | 3                             | 825       |
| 300 - 350               | 325                  | 2                             | 650       |
| TOTAL                   |                      | 30                            | 6150      |

We have got

$$\sum f_i = 30 \text{ & } \sum f_i x_i = 6150$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow \bar{x} = \frac{6150}{30}$$

$$\Rightarrow \bar{x} = 205$$

To find median,

Assume  $\sum f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| DAILY EXPENDITURE (Rs.) | NUMBER OF HOUSEHOLDS( $f_i$ ) | $C_f$          |
|-------------------------|-------------------------------|----------------|
| 100 - 150               | 6                             | 6              |
| 150 - 200               | 7                             | $6 + 7 = 13$   |
| 200 - 250               | 12                            | $13 + 12 = 25$ |
| 250 - 300               | 3                             | $25 + 3 = 28$  |
| 300 - 350               | 2                             | $28 + 2 = 30$  |
| TOTAL                   | 30                            |                |

So,  $N = 30$

$$\Rightarrow N/2 = 30/2 = 15$$

The cumulative frequency just greater than ( $N/2 = 15$ ) is 25, so the corresponding median class is 200 - 250 and accordingly we get  $C_f = 13$ (cumulative frequency before the median class).

Now, since median class is 200 - 250.

$$\therefore l = 200, h = 50, f = 12, N/2 = 15 \text{ and } C_f = 13$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 200 + \left( \frac{15-13}{12} \right) \times 50$$

$$= 200 + 8.33$$

= 208.33

Hence, mean is 205 and median is 208.33

## Exercise : 9E

### Question: 1

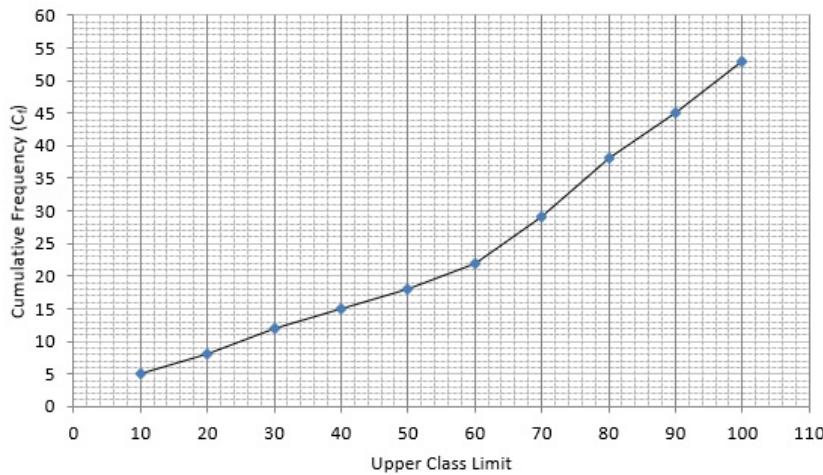
Find the median o

### Solution:

The frequency distribution table for 'less than' type is:

| MARKS         | CUMULATIVE FREQUENCY ( $C_f$ ) |
|---------------|--------------------------------|
| Less than 10  | 5                              |
| Less than 20  | $5 + 3 = 8$                    |
| Less than 30  | $8 + 4 = 12$                   |
| Less than 40  | $12 + 3 = 15$                  |
| Less than 50  | $15 + 3 = 18$                  |
| Less than 60  | $18 + 4 = 22$                  |
| Less than 70  | $22 + 7 = 29$                  |
| Less than 80  | $29 + 9 = 38$                  |
| Less than 90  | $38 + 7 = 45$                  |
| Less than 100 | $45 + 8 = 53$                  |

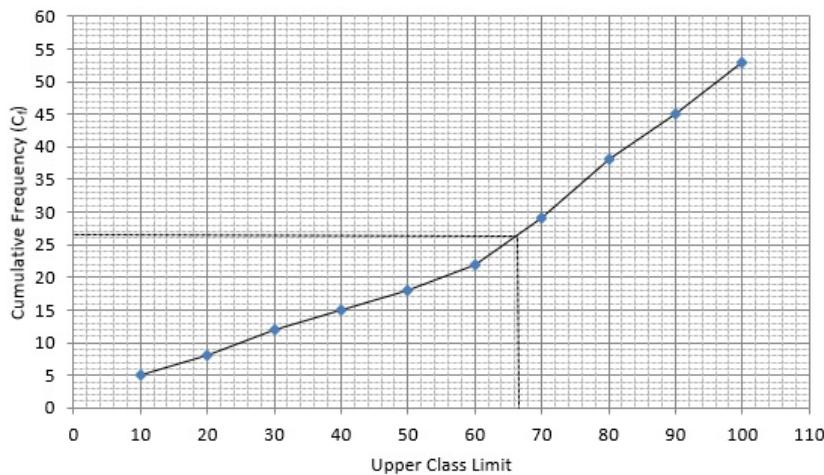
Lets plot a graph of 'less than ogive', taking upper limits of the class intervals on x - axis and cumulative frequencies on y - axis.



As we have  $N = 53$  by the frequency table.

$$N/2 = 53/2 = 26.5$$

Mark 26.5 on y - axis and the corresponding point on x - axis would be the median.



The corresponding point on x - axis is 66.4.

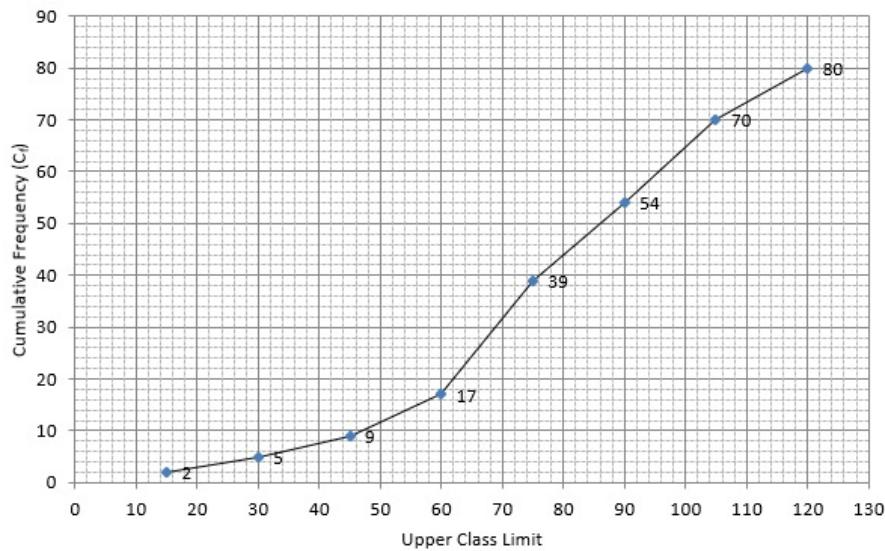
Hence, median is 66.4

### Question: 2

The given distrib

### Solution:

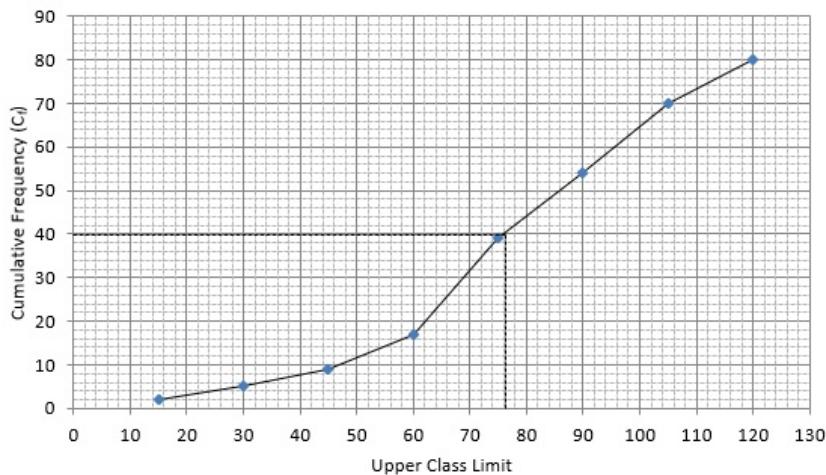
Lets plot a graph of 'less than ogive', taking upper limits of the class intervals on x - axis and cumulative frequencies on y - axis.



As we have  $N = 80$  by the frequency table.

$$N/2 = 80/2 = 40$$

Mark 40 on y - axis and the corresponding point on x - axis would be the median.



The corresponding point on x - axis is 76.

Hence, median is 76.

### Question: 3

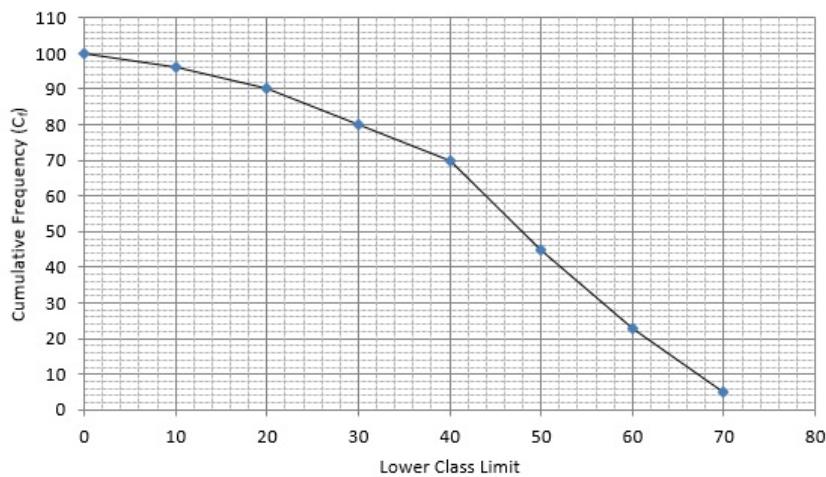
Draw a 'more than'

### Solution:

The frequency distribution table for 'more than' type is:

| MARKS        | CUMULATIVE FREQUENCY ( $C_f$ ) |
|--------------|--------------------------------|
| more than 0  | $96 + 4 = 100$                 |
| more than 10 | $90 + 6 = 96$                  |
| more than 20 | $80 + 10 = 90$                 |
| more than 30 | $70 + 10 = 80$                 |
| more than 40 | $45 + 25 = 70$                 |
| more than 50 | $23 + 22 = 45$                 |
| more than 60 | $5 + 18 = 23$                  |
| more than 70 | 5                              |

Lets plot a graph of 'more than' ogive, taking lower limits of the class intervals on x - axis and cumulative frequencies on y - axis.



#### Question: 4

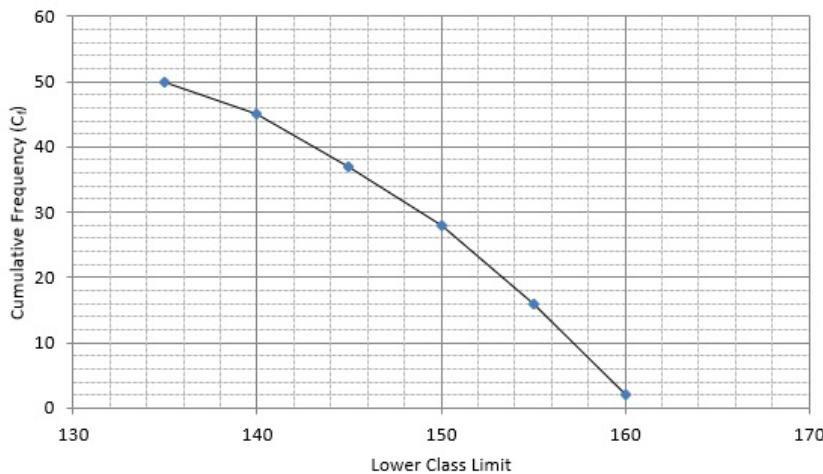
The heights of 50

#### Solution:

The frequency distribution table for 'more than' type is:

| HEIGHT(cm)    | CUMULATIVE FREQUENCY ( $C_f$ ) |
|---------------|--------------------------------|
| more than 135 | $45 + 5 = 50$                  |
| more than 140 | $37 + 8 = 45$                  |
| more than 145 | $28 + 9 = 37$                  |
| more than 150 | $16 + 12 = 28$                 |
| more than 155 | $2 + 14 = 16$                  |
| more than 160 | 2                              |

Lets plot a graph of 'more than' ogive, taking lower limits of the class intervals on x - axis and cumulative frequencies on y - axis.



### Question: 5

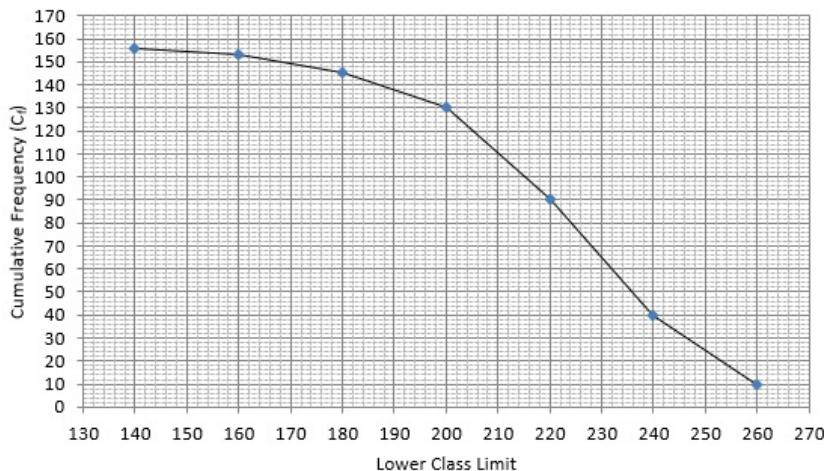
The monthly consu

### Solution:

The frequency distribution table for 'more than' type is:

| HEIGHT(cm)    | CUMULATIVE FREQUENCY ( $C_f$ ) |
|---------------|--------------------------------|
| more than 140 | $153 + 3 = 156$                |
| more than 160 | $145 + 8 = 153$                |
| more than 180 | $130 + 15 = 145$               |
| more than 200 | $90 + 40 = 130$                |
| more than 220 | $40 + 50 = 90$                 |
| more than 240 | $10 + 30 = 40$                 |
| more than 260 | 10                             |

Lets plot a graph of 'more than' ogive, taking lower limits of the class intervals on x - axis and cumulative frequencies on y - axis.



### Question: 6

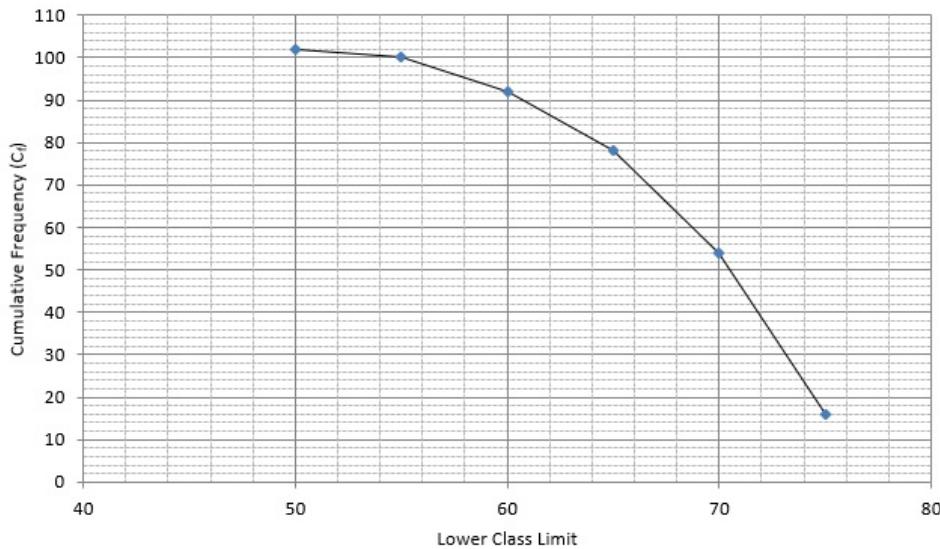
The following tab

#### Solution:

The frequency distribution table for 'more than' type is:

| HEIGHT(cm)   | CUMULATIVE FREQUENCY ( $C_f$ ) |
|--------------|--------------------------------|
| more than 50 | $100 + 2 = 102$                |
| more than 55 | $92 + 8 = 100$                 |
| more than 60 | $78 + 14 = 92$                 |
| more than 65 | $54 + 24 = 78$                 |
| more than 70 | $16 + 38 = 54$                 |
| more than 75 | 16                             |

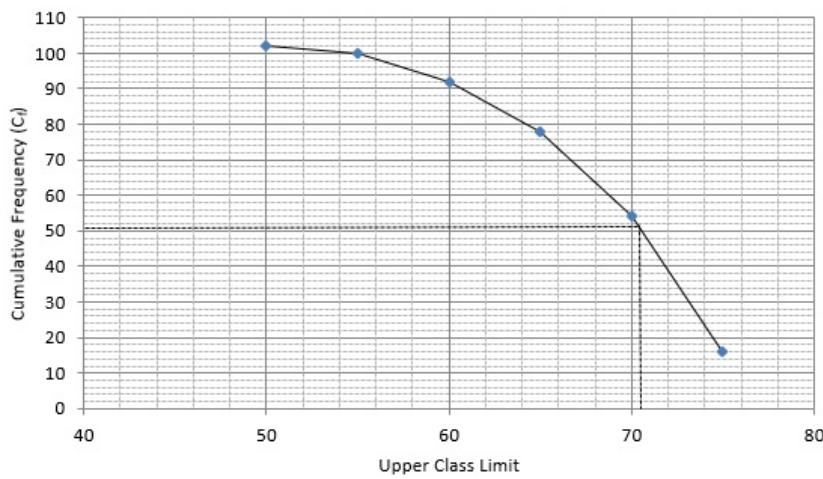
Lets plot a graph of 'more than' ogive, taking lower limits of the class intervals on x - axis and cumulative frequencies on y - axis.



As we have  $N = 102$  by the frequency table.

$$N/2 = 102/2 = 51$$

Mark 51 on y - axis and the corresponding point on x - axis would be the median.



The corresponding point on x - axis is 70.5.

Hence, median is 70.5.

**Question: 7**

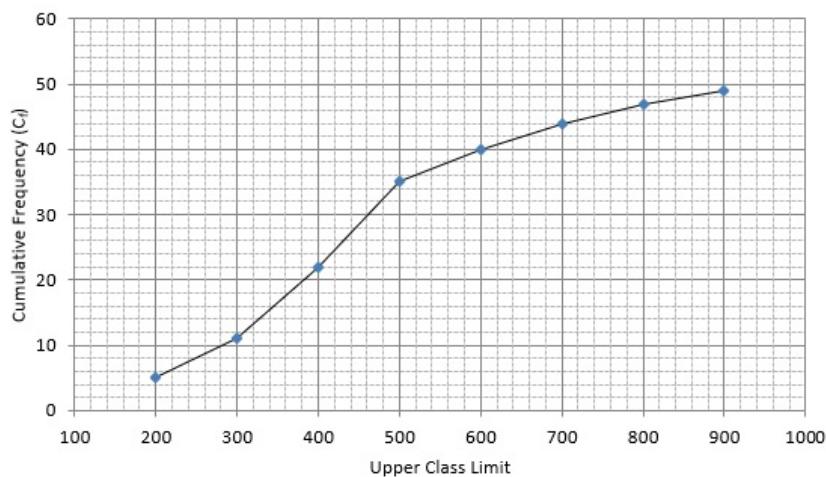
The table given b

**Solution:**

The frequency distribution table for 'less than' type is:

| MARKS         | CUMULATIVE FREQUENCY ( $C_f$ ) |
|---------------|--------------------------------|
| Less than 200 | 5                              |
| Less than 300 | $5 + 6 = 11$                   |
| Less than 400 | $11 + 11 = 22$                 |
| Less than 500 | $22 + 13 = 35$                 |
| Less than 600 | $35 + 5 = 40$                  |
| Less than 700 | $40 + 4 = 44$                  |
| Less than 800 | $44 + 3 = 47$                  |
| Less than 900 | $47 + 2 = 49$                  |

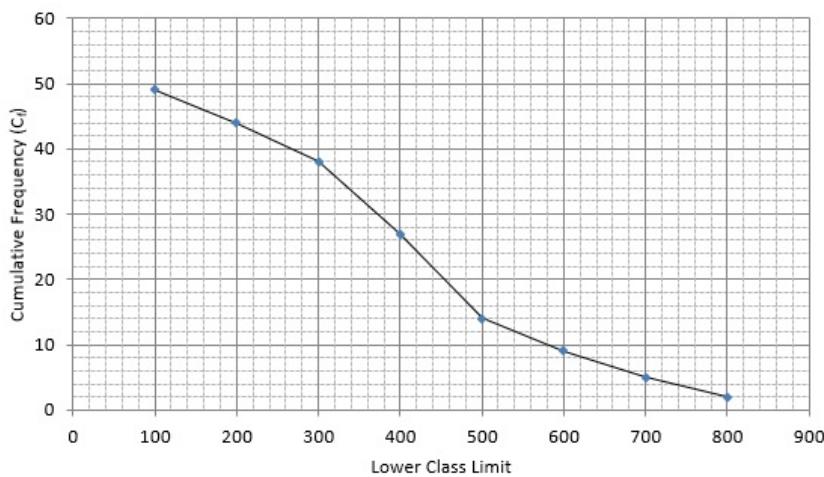
Lets plot the graph of 'less than ogive', taking upper limits of the class intervals on x - axis and cumulative frequencies on y - axis.



The frequency distribution table for 'more than' type is:

| MARKS         | CUMULATIVE FREQUENCY ( $C_f$ ) |
|---------------|--------------------------------|
| more than 100 | $44 + 5 = 49$                  |
| more than 200 | $38 + 6 = 44$                  |
| more than 300 | $27 + 11 = 38$                 |
| more than 400 | $14 + 13 = 27$                 |
| more than 500 | $9 + 5 = 14$                   |
| more than 600 | $5 + 4 = 9$                    |
| more than 700 | $2 + 3 = 5$                    |
| more than 800 | 2                              |

Lets plot a graph of 'more than' ogive, taking lower limits of the class intervals on x - axis and cumulative frequencies on y - axis.



### Question: 8

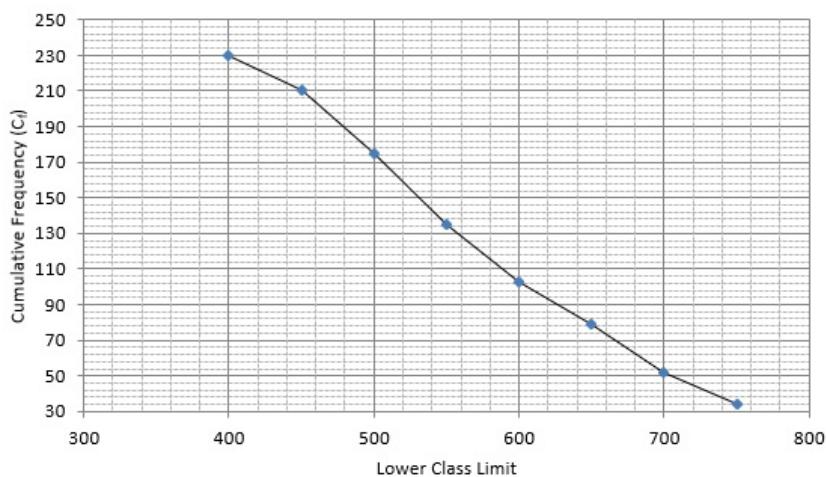
From the followin

### Solution:

The frequency distribution table for 'more than' type is:

| HEIGHT(cm)    | CUMULATIVE FREQUENCY ( $C_f$ ) |
|---------------|--------------------------------|
| more than 400 | $210 + 20 = 230$               |
| more than 450 | $175 + 35 = 210$               |
| more than 500 | $135 + 40 = 175$               |
| more than 550 | $103 + 32 = 135$               |
| more than 600 | $79 + 24 = 103$                |
| more than 650 | $52 + 27 = 79$                 |
| more than 700 | $34 + 18 = 52$                 |
| More than 750 | 34                             |

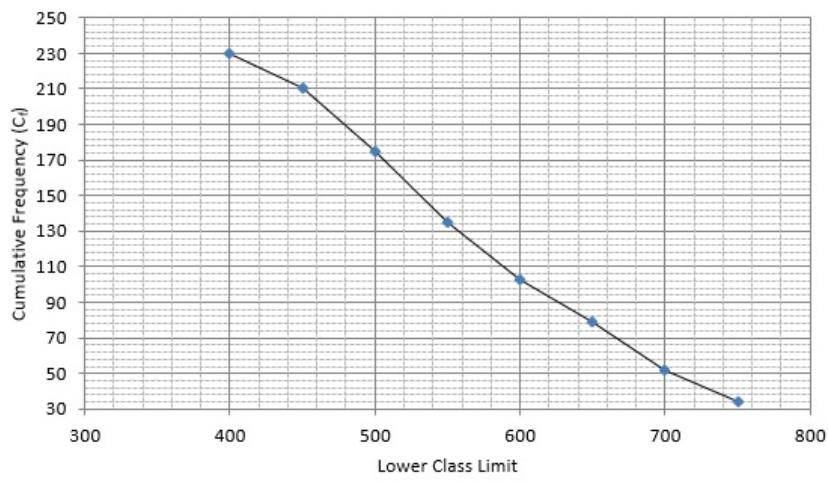
Lets plot a graph of 'more than' ogive, taking lower limits of the class intervals on x - axis and cumulative frequencies on y - axis.



As we have  $N = 230$  by the frequency table.

$$N/2 = 230/2 = 115$$

Mark 115 on y - axis and the corresponding point on x - axis would be the median.



The corresponding point on x - axis is 590.

Hence, median is 590.

**Question: 9**

The marks obtained

**Solution:**

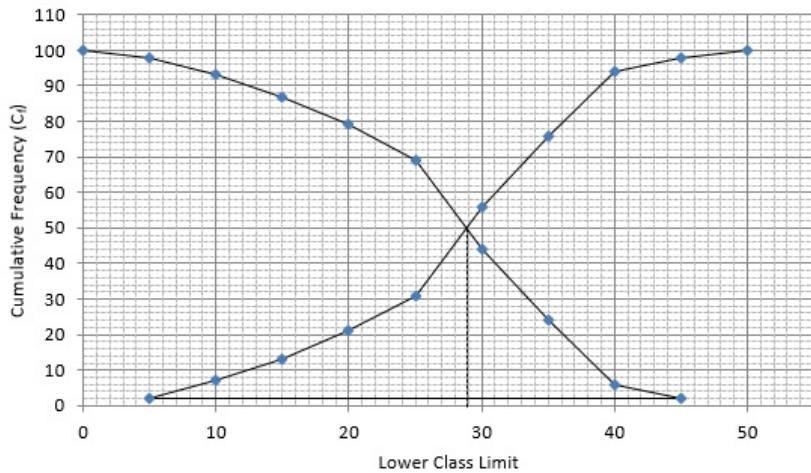
(i) The frequency distribution table for 'less than' type is:

| MARKS        | CUMULATIVE FREQUENCY ( $C_f$ ) |
|--------------|--------------------------------|
| Less than 5  | 2                              |
| Less than 10 | $2 + 5 = 7$                    |
| Less than 15 | $7 + 6 = 13$                   |
| Less than 20 | $13 + 8 = 21$                  |
| Less than 25 | $21 + 10 = 31$                 |
| Less than 30 | $31 + 25 = 56$                 |
| Less than 35 | $56 + 20 = 76$                 |
| Less than 40 | $76 + 18 = 94$                 |
| Less than 45 | $94 + 4 = 98$                  |
| Less than 50 | $98 + 2 = 100$                 |

(ii) The frequency distribution table for 'more than' type is:

| MARKS        | CUMULATIVE FREQUENCY ( $C_f$ ) |
|--------------|--------------------------------|
| More than 0  | $98 + 2 = 100$                 |
| More than 5  | $93 + 5 = 98$                  |
| More than 10 | $87 + 6 = 93$                  |
| More than 15 | $79 + 8 = 87$                  |
| More than 20 | $69 + 10 = 79$                 |
| More than 25 | $44 + 25 = 69$                 |
| More than 30 | $24 + 20 = 44$                 |
| More than 35 | $6 + 18 = 24$                  |
| More than 40 | $2 + 4 = 6$                    |
| More than 45 | 2                              |

Plotting points for 'less - than ogive' and 'more - than ogive' on the graph,



In this type of graph where 'less than ogive' and more than ogive' are plotted in the same graph, median is found on x - axis by the intersection of these two ogives.

Here, median = 29.5

**Question: 10**

From the followin

**Solution:**

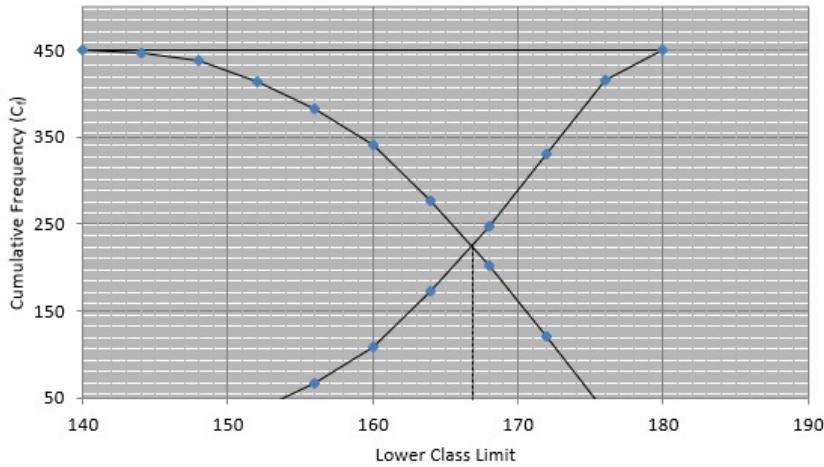
(i) The frequency distribution table for 'less than' type is:

| MARKS         | CUMULATIVE FREQUENCY ( $C_f$ ) |
|---------------|--------------------------------|
| Less than 144 | 3                              |
| Less than 148 | $3 + 9 = 12$                   |
| Less than 152 | $12 + 24 = 36$                 |
| Less than 156 | $36 + 31 = 67$                 |
| Less than 160 | $67 + 42 = 109$                |
| Less than 164 | $109 + 64 = 173$               |
| Less than 168 | $173 + 75 = 248$               |
| Less than 172 | $248 + 82 = 330$               |
| Less than 176 | $330 + 86 = 416$               |
| Less than 180 | $416 + 34 = 450$               |

(ii) The frequency distribution table for 'more than' type is:

| MARKS         | CUMULATIVE FREQUENCY ( $C_f$ ) |
|---------------|--------------------------------|
| More than 140 | $447 + 3 = 450$                |
| More than 144 | $438 + 9 = 447$                |
| More than 148 | $414 + 24 = 438$               |
| More than 152 | $383 + 31 = 414$               |
| More than 156 | $341 + 42 = 383$               |
| More than 160 | $277 + 64 = 341$               |
| More than 164 | $202 + 75 = 277$               |
| More than 168 | $120 + 82 = 202$               |
| More than 172 | $34 + 86 = 120$                |
| More than 176 | 34                             |

Plotting points for 'less - than ogive' and 'more - than ogive' on the graph,



In this type of graph where 'less than ogive' and more than ogive' are plotted in the same graph, median is found on x - axis by the intersection of these two ogives.

Here, median = 166

## Exercise : 9F

### Question: 1

Write the median

### Solution:

To find median class,

Assume  $\Sigma f_i = N = \text{Sum of frequencies}$ ,

$f_i$  = frequency

and  $C_f$  = cumulative frequency

Lets form a table.

| AGE(years) | NUMBER OF PATIENTS( $f_i$ ) | $C_f$          |
|------------|-----------------------------|----------------|
| 0 - 10     | 4                           | 4              |
| 10 - 20    | 4                           | $4 + 4 = 8$    |
| 20 - 30    | 8                           | $8 + 8 = 16$   |
| 30 - 40    | 10                          | $16 + 10 = 26$ |
| 40 - 50    | 12                          | $26 + 12 = 38$ |
| 50 - 60    | 8                           | $38 + 8 = 46$  |
| 60 - 70    | 4                           | $46 + 4 = 50$  |
| TOTAL      | 50                          |                |

$$\text{So, } N = 50$$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 26, so the corresponding median class is 30 - 40.

Hence, median class = 30 - 40

### Question: 2

What is the lower

### Solution:

Here, the maximum class frequency is 27.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 40 - 50

$\therefore$  lower limit of the modal class (l) = 40

### Question: 3

The monthly pocket

### Solution:

Here, the maximum class frequency is 30.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 150 - 200

$\therefore$  lower limit of the modal class (l) = 150

The class mark is found by,

$$\frac{150 + 200}{2} = \frac{350}{2} = 175$$

$\therefore$  Class mark is 175.

**Question: 4**

A data has 25 obs

**Solution:**

Since we have 25 observations, that is odd number of observations, median is found at  $\left(\frac{n+1}{2}\right)^{\text{th}}$  position.

So since, n = 25

$\Rightarrow$  Median will be found at  $\left(\frac{25+1}{2}\right)^{\text{th}}$  position.  $\Rightarrow$  Median = 13<sup>th</sup> observation

**Question: 5**

For a certain dis

**Solution:**

Given: mode = 1000 and median = 1250

The empirical relationship between mean, median and mode is,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$\Rightarrow 2(\text{Mean}) = 3(\text{Median}) - \text{Mode}$$

$$\Rightarrow \text{Mean} = [3(\text{Median}) - \text{Mode}] / 2$$

$$\Rightarrow \text{Mean} = [3(1250) - 1000] / 2$$

$$\Rightarrow \text{Mean} = [3750 - 1000] / 2 = 2750 / 2 = 1375$$

$$\therefore \text{mean} = 1375$$

**Question: 6**

In a class test,

**Solution:**

Here, the maximum class frequency is 25.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 40 - 60

To find median class,

Assume  $\sum f_i = N =$  Sum of frequencies,

$f_i$  = frequency

and  $C_f$  = cumulative frequency

Lets form a table.

| MARKS OBTAINED | NUMBER OF STUDENTS( $f_i$ ) | $C_f$          |
|----------------|-----------------------------|----------------|
| 0 - 20         | 4                           | 4              |
| 20 - 40        | 6                           | $4 + 6 = 10$   |
| 40 - 60        | 25                          | $10 + 25 = 35$ |
| 60 - 80        | 10                          | $35 + 10 = 45$ |
| 80 - 100       | 5                           | $45 + 5 = 50$  |
| TOTAL          | 50                          |                |

$$\text{So, } N = 50$$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 35, so the corresponding median class is 40 - 60.

$\therefore$  modal class = 40 - 60 and median class = 40 - 60

### Question: 7

Find the class ma

#### Solution:

Class mark is given by  $\frac{\text{Upper limit} + \text{Lower limit}}{2}$

$$\text{Class mark of class } 10 - 25 = \frac{10 + 25}{2} = \frac{35}{2} = 17.5$$

$$\text{Class mark of class } 35 - 55 = \frac{35 + 55}{2} = \frac{90}{2} = 45$$

$\therefore$  Class mark of class 10 - 25 is 17.5 and 35 - 55 is 45.

### Question: 8

While calculating

#### Solution:

We have got

$$A = 25, \Sigma f_i = 50 \text{ & } \Sigma f_i d_i = 110$$

$\therefore$  By Assumed - mean method, mean is given by

$$\bar{x} = A + \frac{\sum_i f_i d}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = 25 + \frac{110}{50}$$

$$\Rightarrow \bar{x} = 27.2$$

Thus, mean is 27.2

**Question: 9**

The distributions

**Solution:**

According to the question,

$$4 = \frac{X}{36} \text{ and } 3 = \frac{Y}{64}$$

$$\Rightarrow X = 36 \times 4 = 144 \text{ and } Y = 64 \times 3 = 192$$

We have,  $X = 144$  and  $Y = 192$

Mean of distribution ( $X + Y = 144 + 192 = 336$ ) is,

$$\text{Mean} = 336/(36 + 64) = 336/100 = 3.36$$

Hence, mean = 3.36

**Question: 10**

In a frequency di

**Solution:**

Given: number of classes = 12,

Class width = 2.5, and

Lowest class boundary = 8.1

Upper class is given by,

Upper class boundary = Lower class boundary + (width × number of classes)

Substituting values,

$$\Rightarrow \text{Upper class boundary} = 8.1 + (2.5 \times 12)$$

$$\Rightarrow \text{Upper class boundary} = 8.1 + 30 = 38.1$$

Hence, upper class boundary is 38.1

**Question: 11**

The observations

**Solution:**

Since there are 10 observations, that is, even number of observations, median is found by taking average of  $\left(\frac{n}{2}\right)^{\text{th}}$  and  $\left(\frac{n}{2} + 1\right)^{\text{th}}$  observations.

So, median is found at average of  $\left(\frac{10}{2}\right)^{\text{th}} = (5)^{\text{th}}$  and  $\left(\frac{10}{2} + 1\right)^{\text{th}} = (6)^{\text{th}}$  observations.

$(5)^{\text{th}}$  observation =  $x$  and  $(6)^{\text{th}}$  observation =  $x + 2$

Taking average,

$$\text{Median} = (x + x + 2)/2$$

$$\Rightarrow 63 = (2x + 2)/2 [\because \text{given is median} = 63]$$

$$\begin{aligned}
 & \Rightarrow 126 = 2x + 2 \\
 & \Rightarrow 2x = 126 - 2 \\
 & \Rightarrow 2x = 124 \\
 & \Rightarrow x = 124/2 = 62 \\
 & \therefore x = 62
 \end{aligned}$$

**Question: 12**

The median of 19

**Solution:**

As median is the “middle” number of the sorted list of numbers, and given is median of 19 observations observed to be 30.

$\Rightarrow$  30 is the middle most value amongst 19 observations.

If two more observations (8 and 32) are added, where 8 is less than 30 and 32 is more than 30. 30 is still the middlemost value as the two values are added on either side of 30.

Hence, median of 21 observations are 30.

**Question: 13**

If the median of

**Solution:**

Arranging the values  $x/5$ ,  $x/4$ ,  $x/2$ ,  $x$  and  $x/3$  in ascending order, we get

$x/5$ ,  $x/4$ ,  $x/3$ ,  $x/2$  and  $x$

Here, median is  $x/3$  as it is the middle value amongst all values.

Given: median = 8

$$\Rightarrow x/3 = 8$$

$$\Rightarrow x = 24$$

Hence,  $x = 24$

**Question: 14**

What is the cumul

**Solution:**

Here, the maximum class frequency is 23.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 12 - 15

Lets form a table.

| CLASS   | FREQUENCY( $f_i$ ) | $C_f$          |
|---------|--------------------|----------------|
| 3 - 6   | 7                  | 7              |
| 6 - 9   | 13                 | $7 + 13 = 20$  |
| 9 - 12  | 10                 | $20 + 10 = 30$ |
| 12 - 15 | 23                 | $30 + 23 = 53$ |
| 15 - 18 | 4                  | $53 + 4 = 57$  |
| 18 - 21 | 21                 | $57 + 21 = 78$ |
| 21 - 24 | 16                 | $78 + 16 = 94$ |
| TOTAL   | 94                 |                |

Since, modal class = 12 - 15, the corresponding cumulative frequency is 53.

**Question: 15**

Find the mode of

**Solution:**

Here, the maximum class frequency is 18.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 40 - 60

$\therefore$  lower limit of the modal class ( $l$ ) = 40

Modal class size ( $h$ ) = 20

Frequency of the modal class ( $f_1$ ) = 18

Frequency of class preceding the modal class ( $f_0$ ) = 6

Frequency of class succeeding the modal class ( $f_2$ ) = 10

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 40 + \left( \frac{18-6}{2(18)-6-10} \right) \times 20$$

$$\Rightarrow \text{Mode} = 40 + \left( \frac{12}{20} \right) \times 20$$

$$\Rightarrow \text{Mode} = 40 + 12 = 52$$

Hence, the mode is 52.

**Question: 16**

The following are

**Solution:**

In a 'less than type' cumulative frequency distribution, upper limit of the classes are considered.

It is given by,

| AGE(in years) | CUMULATIVE FREQUENCY( $C_f$ ) |
|---------------|-------------------------------|
| Less than 20  | 60                            |
| Less than 30  | 102                           |
| Less than 40  | 157                           |
| Less than 50  | 227                           |
| Less than 60  | 280                           |
| Less than 70  | 300                           |

**Question: 17**

In the following

**Solution:**

To find p and q, solve by finding cumulative frequency,

| CLASS     | FREQUENCY (f) | CUMULATIVE FREQUENCY ( $C_f$ ) |
|-----------|---------------|--------------------------------|
| 100 - 200 | 11            | 11                             |
| 200 - 300 | 12            | $p = 11 + 12 = 23$             |
| 300 - 400 | 10            | 33                             |
| 400 - 500 | q             | $46 = 33 + q = q = 13$         |
| 500 - 600 | 20            | 66                             |
| 600 - 700 | 14            | 80                             |

$$\Rightarrow p = 11 + 12 = 23$$

$$\text{And } 46 = 33 + q \Rightarrow q = 46 - 33 = 13$$

$$\therefore p = 23 \text{ and } q = 13$$

Lets form the table again,

| CLASS     | FREQUENCY ( $f_i$ ) | CUMULATIVE FREQUENCY ( $C_f$ ) |
|-----------|---------------------|--------------------------------|
| 100 - 200 | 11                  | 11                             |
| 200 - 300 | 12                  | 23                             |
| 300 - 400 | 10                  | 33                             |
| 400 - 500 | 13                  | 46                             |
| 500 - 600 | 20                  | 66                             |
| 600 - 700 | 14                  | 80                             |
| TOTAL     | 80                  |                                |

For modal class,

Here, the maximum class frequency is 20.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 500 - 600

To find median class,

Assume  $\Sigma f_i = N =$  Sum of frequencies,

$f_i$  = frequency

and  $C_f$  = cumulative frequency

So,  $N = 80$

$$\Rightarrow N/2 = 80/2 = 40$$

The cumulative frequency just greater than ( $N/2 = 40$ ) is 46, so the corresponding median class is 400 - 500.

$\therefore$  modal class = 500 - 600 and median class = 400 - 500

### Question: 18

The following fre

### Solution:

In a 'less than type' cumulative frequency distribution, lower limits of the classes are considered.

It is given by,

| MONTHLY CONSUMPTION (in units) | CUMULATIVE FREQUENCY( $C_f$ ) |
|--------------------------------|-------------------------------|
| More than 65                   | $60 + 4 = 64$                 |
| More than 85                   | $55 + 5 = 60$                 |
| More than 105                  | $42 + 13 = 55$                |
| More than 125                  | $22 + 20 = 42$                |
| More than 145                  | $8 + 14 = 22$                 |
| More than 165                  | 8                             |

**Question: 19**

The following tab

**Solution:**

| LIFE TIME (in days) | NUMBER OF BULBS |
|---------------------|-----------------|
| 0 - 50              | 7               |
| 50 - 100            | $21 - 7 = 14$   |
| 100 - 150           | $52 - 21 = 31$  |
| 150 - 200           | $79 - 52 = 27$  |
| 200 - 250           | $91 - 79 = 12$  |
| 250 - 300           | $100 - 91 = 9$  |

The frequency distribution table is:

### Question: 20

The following tab

#### Solution:

- (a) To convert the given frequency distribution into continuous form, adjust the end - limits of each class.

| MARKS OBTAINED (in percent) | NUMBER OF STUDENTS ( $f_i$ ) |
|-----------------------------|------------------------------|
| 10.5 - 20.5                 | 141                          |
| 20.5 - 30.5                 | 221                          |
| 30.5 - 40.5                 | 439                          |
| 40.5 - 50.5                 | 529                          |
| 50.5 - 60.5                 | 495                          |
| 60.5 - 70.5                 | 322                          |
| 70.5 - 80.5                 | 153                          |

(b) To find median class,

Assume  $\Sigma f_i = N = \text{Sum of frequencies}$ ,

$f_i$  = frequency

and  $C_f$  = cumulative frequency

| MARKS OBTAINED (in percent) | NUMBER OF STUDENTS ( $f_i$ ) | $C_f$               |
|-----------------------------|------------------------------|---------------------|
| 10.5 - 20.5                 | 141                          | 141                 |
| 20.5 - 30.5                 | 221                          | $141 + 221 = 362$   |
| 30.5 - 40.5                 | 439                          | $362 + 439 = 801$   |
| 40.5 - 50.5                 | 529                          | $801 + 529 = 1330$  |
| 50.5 - 60.5                 | 495                          | $1330 + 495 = 1825$ |
| 60.5 - 70.5                 | 322                          | $1825 + 322 = 2147$ |
| 70.5 - 80.5                 | 153                          | $2147 + 153 = 2300$ |
| TOTAL                       | 2300                         |                     |

$$\text{So, } N = 2300$$

$$\Rightarrow N/2 = 2300/2 = 1150$$

The cumulative frequency just greater than ( $N/2 = 1150$ ) is 1825, so the corresponding median class is 50.5 - 60.5.

$$\therefore \text{median class} = 50.5 - 60.5$$

$$\text{The class mark of } 50.5 - 60.5 \text{ is } \frac{50.5 + 60.5}{2} = \frac{111}{2} = 55.5$$

(c) For modal class,

Here, the maximum class frequency is 529.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 40.5 - 50.5

The cumulative frequency corresponding to the modal class is 1330

### Question: 21

If the mean of th

### Solution:

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$  |
|---------|----------------------|--------------------|------------|
| 0 - 10  | 5                    | 8                  | 40         |
| 10 - 20 | 15                   | p                  | 15p        |
| 20 - 30 | 25                   | 12                 | 300        |
| 30 - 40 | 35                   | 13                 | 455        |
| 40 - 50 | 45                   | 10                 | 450        |
| TOTAL   |                      | 43 + p             | 1245 + 15p |

We have got

$$\Sigma f_i = 43 + p \text{ and } \Sigma f_i x_i = 1245 + 15p$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow 27 = \frac{1245 + 15p}{43 + p} (\because \text{given: mean of pocket allowance is 27})$$

$$\Rightarrow 1161 + 27p = 1245 + 15p$$

$$\Rightarrow 27p - 15p = 1245 - 1161$$

$$\Rightarrow 12p = 84$$

$$\Rightarrow p = 84/12$$

$$\Rightarrow p = 7$$

Thus,  $p = 7$

### Question: 22

Calculate the mis

#### Solution:

Given: Median = 24

Let the unknown frequency be  $x$ .

Assume

$\Sigma f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table, where  $x$  is the unknown frequency.

| AGE (in years) | NUMBER OF PERSONS( $f_i$ ) | $C_f$                  |
|----------------|----------------------------|------------------------|
| 0 - 10         | 5                          | 5                      |
| 10 - 20        | 25                         | $5 + 25 = 30$          |
| 20 - 30        | $x$                        | $30 + x$               |
| 30 - 40        | 18                         | $30 + x + 18 = 48 + x$ |
| 40 - 50        | 7                          | $48 + x + 7 = 55 + x$  |
| TOTAL          | $55 + x$                   |                        |

Median = 24 (as already mentioned in the question)

24 lies between 20 - 30  $\Rightarrow$  Median class = 20 - 30

$\therefore l = 20, h = 10, f = x, N/2 = (55 + x)/2$  and  $C_f = 30$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow 24 = 20 + \left( \frac{\frac{55+x}{2} - 30}{x} \right) \times 10$$

$$\Rightarrow 24 = 20 + \left( \frac{55+x-60}{2x} \right) \times 10$$

$$\Rightarrow 24 - 20 = (5x - 25)/x$$

$$\Rightarrow 4x = 5x - 25$$

$$\Rightarrow 5x - 4x = 25$$

$$\Rightarrow x = 25$$

## Exercise : MULTIPLE CHOICE QUESTIONS (MCQ)

**Question: 1**

Which of the following is not a measure of central tendency?

**Solution:**

Mean, median and mode are measures of central tendency but range of a set of data is the difference between the largest and smallest values.

**Question: 2**

Which of the following is not a measure of central tendency?

**Solution:**

Mean is just the average of some observations. It cannot be determined graphically as the values cannot be summed up.

**Question: 3**

Which of the following is not a measure of central tendency?

**Solution:**

Mean is influenced by extreme values in class intervals, while median and mode is not influenced by extreme values as median is the mid value among observations and mode is the value that is come often in a set of data values and they are independent of extreme values.

**Question: 4**

The mode of a frequency distribution can be obtained from

**Solution:**

A histogram shows frequencies of values and mode of frequency distribution can be obtained from a histogram.

**Question: 5**

The median of a frequency distribution can be obtained from

**Solution:**

An ogive is a type of frequency polygon that shows cumulative frequencies and median is the mid-value among given values. Graphically, median can be found by ogive as corresponding to one axis, we get the value on the other axis in an ogive.

**Question: 6**

The cumulative frequency distribution can be obtained from

**Solution:**

Cumulative frequency table is useful in determining the median in the case of class intervals.

**Question: 7**

The abscissa of the point of intersection of the 'less than type' and 'more than type' cumulative frequency curves of the grouped data gives its median as it gives accurate mid-point among all values.

**Question: 8**

If  $x_i'$

**Solution:**

If mean = 7,  $x_i'$ 's = midpoints of the class intervals and  $f_i$  = corresponding frequencies

Mean is given by,

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow \bar{x} \sum f_i = \sum f_i x_i$$

$$\text{Or } \sum f_i \bar{x} = \sum f_i x_i$$

$$\text{Or } \sum f_i \bar{x} - \sum f_i x_i = 0$$

$$\text{Or } \sum f_i (x_i - \bar{x}) = 0$$

**Question: 9**

For finding the m

**Solution:**

Since,  $d_i = x_i - A$ ,

where  $d_i$  = deviation and  $A$  = Assumed mean

And  $u_i = d_i/h = (x_i - A)/h$ ,

where  $h$  = class width

**Question: 10**

In the formula, <

**Solution:**

For finding the mean of the grouped data,  $d_i$ 's are deviations from  $A$ (Assumed mean) of the midpoints of the classes. It is necessary to find midpoints of the class intervals to find mean of the grouped data.

**Question: 11**

While computing t

**Solution:**

Class marks are the aggregates value of the classes and is given by:

Class mark = (lower limit + upper limit)/2

And the frequencies are Assumed to be centered at the class marks of the classes.

**Question: 12**

The relation betw

**Solution:**

This relationship between mean, median and mode is also called empirical relationship and is given by,

mode = (3 × median) - (2 × mean)

**Question: 13**

If the 'less than'

**Solution:**

If 'less than type' ogive and 'more than type' ogive intersect each other at (20.5, 15.5), then median of the given data is 20.5 as median in this kind of graph is found on x - axis, which represents class intervals (upper limit/lower limit).

**Question: 14**

Consider the freq

**Solution:**

To find median class,

Assume  $\Sigma f_i = N$  = Sum of frequencies,

$f_i$  = frequency

and  $C_f$  = cumulative frequency

| HEIGHT (in cm) | NUMBER OF STUDENTS | CUMULATIVE FREQUENCY ( $C_f$ ) |
|----------------|--------------------|--------------------------------|
| 150 - 155      | 16                 | 16                             |
| 155 - 160      | 12                 | 28                             |
| 160 - 165      | 9                  | 37                             |
| 165 - 170      | 7                  | 44                             |
| 170 - 175      | 10                 | 54                             |
| 175 - 180      | 6                  | 60                             |
| TOTAL          | 60                 |                                |

So,  $N = 60$

$$\Rightarrow N/2 = 60/2 = 30$$

The cumulative frequency just greater than ( $N/2 = 30$ ) is 37, so the corresponding median class is 160 - 165.

$\therefore$  upper limit of median class = 165

For modal class,

Here, the maximum class frequency is 16.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 150 - 155

$\therefore$  lower limit of the modal class = 150

Hence, Sum of lower limit of the modal class and upper limit of the median class =  $165 + 150 = 315$

### Question: 15

Consider the foll

### Solution:

For modal class,

Here, the maximum class frequency is 30.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 30 - 40

$\therefore$  modal class = 30 - 40

**Question: 16**

Mode = ?

**Solution:**

Mode is given by,

$$\text{Mode} = x_k + h \left( \frac{f_k - f_{k-1}}{2f_k - f_{k-1} - f_{k+1}} \right)$$

where,

$x_k$  = lower limit of the modal class,

$h$  = class width,

$f_k$  = frequency of the modal class,

$f_{k-1}$  = frequency of class preceding the modal class

and  $f_{k+1}$  = frequency of class succeeding the modal class

**Question: 17**

Median = ?

**Solution:**

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

Where

$N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

**Question: 18**

If the mean and  $m$

**Solution:**

Given: mean = 8.9 and median = 9

By empirical formula,

mode =  $(3 \times \text{median}) - (2 \times \text{mean})$

$\Rightarrow$  mode =  $(3 \times 9) - (2 \times 8.9)$

$\Rightarrow$  mode =  $27 - 17.8 = 9.2$

**Question: 19**

Look at the frequ

**Solution:**

To find median,

Assume  $\Sigma f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table.

| CLASS INTERVAL | FREQUENCY( $f_i$ ) | $C_f$          |
|----------------|--------------------|----------------|
| 35 - 45        | 8                  | 8              |
| 45 - 55        | 12                 | $8 + 12 = 20$  |
| 55 - 65        | 20                 | $20 + 20 = 40$ |
| 65 - 75        | 10                 | $40 + 10 = 50$ |
| TOTAL          | 50                 |                |

So,  $N = 50$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 40, so the corresponding median class is 55 - 65 and accordingly we get  $C_f = 20$  (cumulative frequency before the median class).

Now, since median class is 55 - 65.

$$\therefore l = 55, h = 10, f = 20, N/2 = 25 \text{ and } C_f = 20$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 55 + \left( \frac{25-20}{20} \right) \times 10$$

$$= 55 + 2.5$$

$$= 57.5$$

Thus, median age is 57.5.

### Question: 20

Consider the foll

**Solution:**

Here, the maximum class frequency is 25.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 22 - 26

$\therefore$  lower limit of the modal class (l) = 22

Modal class size (h) = 4

Frequency of the modal class ( $f_1$ ) = 25

Frequency of class preceding the modal class ( $f_0$ ) = 16

Frequency of class succeeding the modal ( $f_2$ ) = 19

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 22 + \left( \frac{25-16}{2(25)-16-19} \right) \times 4$$

$$\Rightarrow \text{Mode} = 22 + \left( \frac{9}{15} \right) \times 4$$

$$\Rightarrow \text{Mode} = 22 + 2.4 = 24.4$$

Hence, the mode is 24.4.

**Question: 21**

The mean and mode

**Solution:**

Given: mean = 28 and mode = 16

By empirical formula,

$$\text{mode} = (3 \times \text{median}) - (2 \times \text{mean})$$

$$\Rightarrow 3 \times \text{median} = \text{mode} + (2 \times \text{mean})$$

$$\Rightarrow 3 \times \text{median} = 16 + (2 \times 28)$$

$$\Rightarrow 3 \times \text{median} = 16 + 56$$

$$\Rightarrow 3 \times \text{median} = 72$$

$$\Rightarrow \text{median} = 72/3 = 24$$

**Question: 22**

The median and mo

**Solution:**

Given: median = 26 and mode = 29

By empirical formula,

$$\text{mode} = (3 \times \text{median}) - (2 \times \text{mean})$$

$$\Rightarrow 2 \times \text{mean} = (3 \times \text{median}) - \text{mode}$$

$$\Rightarrow 2 \times \text{mean} = (3 \times 26) - 29$$

$$\Rightarrow 2 \times \text{mean} = 78 - 29$$

$$\Rightarrow 2 \times \text{mean} = 49$$

$$\Rightarrow \text{mean} = 49/2 = 24.5$$

**Question: 23**

For a symmetrical

**Solution:**

As in a symmetrical frequency distribution, the left and right hand side of the distribution is roughly equally balanced around the mean of the distribution.

**Question: 24**

Look at the cumul

**Solution:**

| MONTHLY INCOME  | NUMBER OF FAMILIES | FREQUENCY ( $f_i$ ) |
|-----------------|--------------------|---------------------|
| 10000 - 14000   | 100                | $100 - 85 = 15$     |
| 14000 - 18000   | 85                 | $85 - 69 = 16$      |
| 18000 - 20000   | 69                 | $69 - 50 = 19$      |
| 20000 - 25000   | 50                 | $50 - 37 = 13$      |
| 25000 - 30000   | 37                 | $37 - 15 = 22$      |
| 30000 and above | 15                 | 15                  |

From the above table, number of families having income range 20000 - 25000 is 13. (Observe the frequency values corresponding to the monthly income)

**Question: 25**

The median of fir

**Solution:**

Listing out all first 8 prime numbers, we have

2, 3, 5, 7, 11, 13, 17, 19

Since, the median will be at the aggregate of the  $(8/2 = ) 4^{\text{th}}$  position and  $(8/2 + 1 = ) 5^{\text{th}}$  position.

We have,  $(7 + 11)/2 = 18/2 = 9$

Thus, median is 9.

**Question: 26**

The mean of 20 nu

**Solution:**

It's given that mean of 20 numbers is 0, which implies that average of 20 numbers is 0.

This means that Sum of 20 numbers is 0.

If Sum of 19 numbers out of 20 is  $x$ (say), then the 20<sup>th</sup> number will be absolutely 0 for the average to be 0.

$\Rightarrow$  At the most, 19 numbers will be positive.

**Question: 27**

If the median of

**Solution:**

Since there are 6 number of observation in all, which is an even number of observation.

Median will be found at the aggregate of  $(6/2 = ) 3^{\text{rd}}$  and  $(6/2 + 1 = ) 4^{\text{th}}$  position.

$3^{\text{rd}}$  value =  $x - 1$  and  $4^{\text{th}}$  value =  $x - 3$

Taking their aggregate, we get

$$\text{Median} = (x - 1 + x - 3)/2$$

$$\Rightarrow 13 = (2x - 4)/2 [\because \text{median} = 13]$$

$$\Rightarrow 26 = 2x - 4$$

$$\Rightarrow 2x = 26 + 4$$

$$\Rightarrow 2x = 30$$

$$\Rightarrow x = 15$$

Thus, median is 15.

**Question: 28**

The mean of 2, 7,

**Solution:**

Given: mean of 2, 7, 6 and  $x$  is 15

$$\text{Mean} = \frac{\text{sum of observations}}{\text{number of observation}}$$

$$\Rightarrow 15 = \frac{2 + 7 + 6 + x}{4}$$

$$\Rightarrow 60 = 15 + x$$

$$\Rightarrow x = 60 - 15 = 45 \dots(i)$$

Also, given that mean of 18, 1, 6,  $x$  and  $y$  is 10

$$10 = \frac{18 + 1 + 6 + x + y}{5} [\because \text{mean} = 10]$$

$$\Rightarrow 50 = 25 + 45 + y = 70 + y \text{ [from equation (i)]}$$

$$\Rightarrow y = 50 - 70 = -20$$

Thus,  $y = -20$

**Question: 29**

Match the followi

**Solution:**

| Column I  | Column II              | Explanation  |
|---|------------------------|--|
| (a) The most frequent value in a data is known as .....   | (s) mode               | The most frequent value in the data is known as mode, as mode is the value that occurs most often (as per its definition).   |
| (b) Which of the following cannot be determined graphically out of mean, mode and median?         | (r) mean               | Mean cannot be determined graphically, as mean is the average value from the set of given observations. Also, it doesn't find the average of qualitative data, so it cannot be found by graph. |
| (c) An ogive is used to determine .....   | (q) median             | An ogive is used to determine median, as median is just the middle most value in the given set of observation which can be obtained by 'less than type' or 'more than type' ogives.            |
| (d) Out of mean, mode, median and standard deviation, which is not a measure of central tendency? | (p) standard deviation | Standard deviation is not a measure of central tendency, as standard deviation is the deviation from the mean value for a group of observation. It doesn't represent central tendency.         |

The correct answer is:

### Question: 30

Each question con

#### Solution:

According to Reason(R),

Relationship between mean, median and mode is,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

If we substitute the values given in the above relationship,

$$\text{Median} = 150 \text{ and Mean} = 148 \text{ (given)}$$

$$\text{Mode} = 3(150) - 2(148)$$

$$\Rightarrow \text{Mode} = 450 - 296 = 154$$

We get mode = 154, which satisfies the assertion.

Thus, Assertion(A) and Reason(R) are true and Reason(R) is the correct explanation of the Assertion(A).

### Question: 31

Each question con

#### Solution:

Here, the maximum class frequency is 23.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 12 - 15

$\therefore$  lower limit of the modal class (l) = 12

Modal class size (h) = 3

Frequency of the modal class ( $f_1$ ) = 23

Frequency of class preceding the modal class ( $f_0$ ) = 21

Frequency of class succeeding the modal class ( $f_2$ ) = 10

Mode is given by,

$$\text{Mode} = l + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow \text{Mode} = 12 + \left( \frac{23-21}{2(23)-21-10} \right) \times 3$$

$$= 12 + \left( \frac{2}{15} \right) \times 3$$

$$= 12 + 0.4 = 12.4$$

$\therefore$  Assertion (A) is true and Reason (R) is true obviously.

But Reason (R) is not the correct explanation of Assertion (A).

Thus, Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

## Exercise : FORMATIVE ASSESSMENT (UNIT TEST)

### Question: 1

Which one of the

#### Solution:

Mean and mode does not require construction of cumulative frequency, but median necessarily requires construction of cumulative frequency, unless it is raw data (in which median is the  $(n/2)^{\text{th}}$  value, when there are  $n$  number of observations; and the average of  $(n/2)^{\text{th}}$  and  $(n/2 + 1)^{\text{th}}$  values, when there are  $n$  observations).

### Question: 2

If the mean of a

#### Solution:

Given: mean = 27 and median = 33

We have to find the value of mode.

Empirical relationship is given by,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$\Rightarrow \text{Mode} = 3(33) - 2(27)$$

$$\Rightarrow \text{Mode} = 99 - 54 = 45$$

**Question: 3**

Consider the foll

**Solution:**

We need to find - (1) Median class

(2) Modal class

First we'll find (1) Median class.

To find median class,

Assume  $\sum f_i = N = \text{Sum of frequencies}$ ,

$f_i$  = frequency of class intervals

and  $C_f$  = cumulative frequency

Lets form a table.

| CLASS INTERVAL | FREQUENCY( $f_i$ ) | $C_f$          |
|----------------|--------------------|----------------|
| 0 - 5          | 10                 | 10             |
| 5 - 10         | 15                 | $10 + 15 = 25$ |
| 10 - 15        | 12                 | $25 + 12 = 37$ |
| 15 - 20        | 20                 | $37 + 20 = 57$ |
| 20 - 25        | 9                  | $57 + 9 = 66$  |
| TOTAL          | 66                 |                |

So,  $N = 66$

$$\Rightarrow N/2 = 66/2 = 33$$

The cumulative frequency just greater than ( $N/2 = 33$ ) is 37, so the corresponding median class is 10 - 15.

$\therefore$  median class is 10 - 15.

To find (2) Modal class,

Here, the maximum class frequency is 20.

The class corresponding to this frequency is the modal class.  $\Rightarrow$  modal class = 15 - 20

Lower limit of median = 10 and lower limit of mode = 15

Sum =  $10 + 15 = 25$

**Question: 4**

Consider the foll

**Solution:**

To find median class,

Assume  $\sum f_i = N = \text{Sum of frequencies}$ ,

$f_i$  = frequency of class intervals

and  $C_f$  = cumulative frequency

Lets convert this data into exclusive type of data.

| CLASS INTERVAL | FREQUENCY( $f_i$ ) | $C_f$          |
|----------------|--------------------|----------------|
| - 0.5 - 5.5    | 13                 | 13             |
| 5.5 - 11.5     | 10                 | $13 + 10 = 23$ |
| 11.5 - 17.5    | 15                 | $23 + 15 = 38$ |
| 17.5 - 23.5    | 8                  | $38 + 8 = 46$  |
| 23.5 - 29.5    | 11                 | $46 + 11 = 57$ |
| TOTAL          | 57                 |                |

So,  $N = 57$

$$\Rightarrow N/2 = 57/2 = 28.5$$

The cumulative frequency just greater than ( $N/2 = 28.5$ ) is 38, so the corresponding median class is 11.5 - 17.5.

$\therefore$  Upper limit of this median class = 17.5

**Question: 5**

If the mean and m

**Solution:**

Given: mean = 53.4 and mode = 55.2

We have to find the median.

By empirical formula,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$\Rightarrow 3(\text{Median}) = \text{Mode} + 2(\text{Mean})$$

$$\Rightarrow \text{Median} = [\text{Mode} + 2(\text{Mean})]/3$$

$$\Rightarrow \text{Median} = [55.2 + 2(53.4)]/3$$

$$\Rightarrow \text{Median} = [55.2 + 106.8]/3$$

$$\Rightarrow \text{Median} = 162/3 = 54$$

$$\therefore \text{Median} = 54$$

**Question: 6**

In the table give

**Solution:**

We need to form a 'less than type' table to solve this.

| CLASS          | FREQUENCY | CUMULATIVE FREQUENCY ( $C_f$ ) |
|----------------|-----------|--------------------------------|
| Less than 14   | 2         | 2                              |
| Less than 14.2 | 4         | $2 + 4 = 6$                    |
| Less than 14.4 | 15        | $6 + 15 = 21$                  |
| Less than 14.6 | 54        | $21 + 54 = 75$                 |
| Less than 14.8 | 25        | $75 + 25 = 100$                |
| Less than 15   | 20        | $100 + 20 = 120$               |

Here, cumulative frequency shows number of athletes taking different time intervals to run a 100 - m - hurdle race.

So by the table, there are 75 athletes who completed the race in less than 14.6 seconds.

**Question: 7**

Consider the foll

**Solution:**

To find median class,

Assume  $\Sigma f_i = N = \text{Sum of frequencies}$ ,

$f_i$  = frequency of class intervals

and  $C_f$  = cumulative frequency

Lets convert this data into exclusive type of data.

| CLASS INTERVAL | FREQUENCY( $f_i$ ) | $C_f$          |
|----------------|--------------------|----------------|
| - 0.5 - 5.5    | 13                 | 13             |
| 5.5 - 11.5     | 10                 | $13 + 10 = 23$ |
| 11.5 - 17.5    | 15                 | $23 + 15 = 38$ |
| 17.5 - 23.5    | 8                  | $38 + 8 = 46$  |
| 23.5 - 29.5    | 11                 | $46 + 11 = 57$ |
| TOTAL          | 57                 |                |

So,  $N = 57$

$$\Rightarrow N/2 = 57/2 = 28.5$$

The cumulative frequency just greater than ( $N/2 = 28.5$ ) is 38, so the corresponding median class is 11.5 - 17.5.

$\therefore$  Upper limit of this median class = 17.5

### Question: 8

The annual profit

### Solution:

To find frequency corresponding to 20 - 25 class, we need to convert 'more than or equal to' type

data into class intervals.

| PROFIT (in lakhs) | FREQUENCY      |
|-------------------|----------------|
| 5 - 10            | $30 - 28 = 2$  |
| 10 - 15           | $28 - 16 = 12$ |
| 15 - 20           | $16 - 14 = 2$  |
| 20 - 25           | $14 - 10 = 4$  |
| 25 - 30           | $10 - 7 = 3$   |
| 30 - 35           | $7 - 3 = 4$    |
| 35 - 40           | 3              |

Observe in the table above, frequency corresponding to the class 20 - 25 is 4.

**Question: 9**

Find the mean of

**Solution:**

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|-------|----------------------|--------------------|-----------|
| 1 - 3 | 2                    | 9                  | 18        |
| 3 - 5 | 4                    | 22                 | 88        |
| 5 - 7 | 6                    | 27                 | 162       |
| 7 - 9 | 8                    | 18                 | 144       |
| TOTAL |                      | 76                 | 412       |

We have got

$$\Sigma f_i = 76 \text{ & } \Sigma f_i x_i = 412$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{412}{76}$$

$$\Rightarrow \bar{x} = 5.421$$

Thus, mean is 5.421

### Question: 10

The maximum bowl

#### Solution:

To find median, Assume

$\Sigma f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f =$  cumulative frequency

Lets form a table.

| SPEED(in km/hr) | NUMBER OF PLAYERS( $f_i$ ) | $C_f$         |
|-----------------|----------------------------|---------------|
| 85 - 100        | 10                         | 10            |
| 100 - 115       | 4                          | $10 + 4 = 14$ |
| 115 - 130       | 7                          | $14 + 7 = 21$ |
| 130 - 145       | 9                          | $21 + 9 = 30$ |
| TOTAL           | 30                         |               |

So,  $N = 30$

$$\Rightarrow N/2 = 30/2 = 15$$

The cumulative frequency just greater than ( $N/2 = 15$ ) is 21, so the corresponding median class is 115 - 130 and accordingly we get  $C_f = 14$  (cumulative frequency before the median class).

Now, since median class is 115 - 130.

$$\therefore l = 115, h = 15, f = 7, N/2 = 15 \text{ and } C_f = 14$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 115 + \left( \frac{15-14}{7} \right) \times 15$$

$$= 115 + 2.14$$

$$= 117.14$$

Thus, median is 117.14 km/hr.

### Question: 11

The arithmetic me

### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$  |
|---------|----------------------|--------------------|------------|
| 0 - 10  | 5                    | 16                 | 80         |
| 10 - 20 | 15                   | p                  | 15p        |
| 20 - 30 | 25                   | 30                 | 750        |
| 30 - 40 | 35                   | 32                 | 1120       |
| 40 - 50 | 45                   | 14                 | 630        |
| TOTAL   |                      | 92 + p             | 2580 + 15p |

We have got

$$\Sigma f_i = 92 + p \text{ and } \Sigma f_i x_i = 2580 + 15p$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow 50 = \frac{2580 + 15p}{92 + p} (\because \text{given: arithmetic mean is 50})$$

$$\Rightarrow 4600 + 50p = 2580 + 15p$$

$$\Rightarrow 50p - 15p = 2580 - 4600$$

$$\Rightarrow 35p = 2020$$

$$\Rightarrow p = 11$$

Thus, p is 11.

### Question: 12

Find the median o

#### Solution:

To find median, Assume

$\Sigma f_i = N =$  Sum of frequencies,

$h =$  length of median class,

$l =$  lower boundary of the median class,

$f =$  frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table.

| MARKS   | NUMBER OF STUDENTS( $f_i$ ) | $C_f$          |
|---------|-----------------------------|----------------|
| 0 - 10  | 6                           | 6              |
| 10 - 20 | 16                          | $6 + 16 = 22$  |
| 20 - 30 | 30                          | $22 + 30 = 52$ |
| 30 - 40 | 9                           | $52 + 9 = 61$  |
| 40 - 50 | 4                           | $61 + 4 = 65$  |
| TOTAL   | 65                          |                |

So,  $N = 65$

$$\Rightarrow N/2 = 65/2 = 32.5$$

The cumulative frequency just greater than ( $N/2 = 32.5$ ) is 52, so the corresponding median class is 20 - 30 and accordingly we get  $C_f = 22$ (cumulative frequency before the median class).

Now, since median class is 20 - 30.

$$\therefore l = 20, h = 10, f = 30, N/2 = 32.5 \text{ and } C_f = 22$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 20 + \left( \frac{32.5 - 22}{30} \right) \times 10$$

$$= 20 + 3.5$$

$$= 23.5$$

Thus, median is 23.5.

### Question: 13

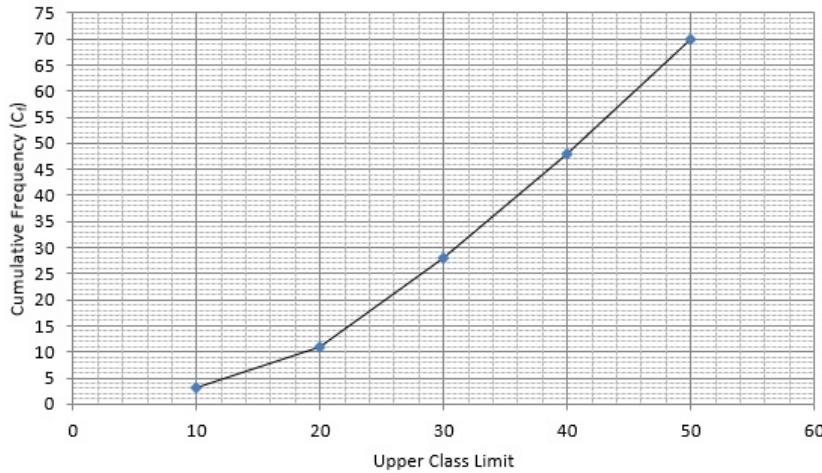
Following is the

### Solution:

The frequency distribution table for 'less than' type is:

| MARKS        | CUMULATIVE FREQUENCY ( $C_f$ ) |
|--------------|--------------------------------|
| Less than 10 | 3                              |
| Less than 20 | 11                             |
| Less than 30 | 28                             |
| Less than 40 | 48                             |
| Less than 50 | 70                             |

Lets plot a graph of 'less than ogive', taking upper limits of the class intervals on x - axis and cumulative frequencies on y - axis.



#### Question: 14

Find the median o

#### Solution:

To find median, Assume

$\Sigma f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table and convert it into exclusive - type by adjusting from both ends of a class.

| MARKS   | NUMBER OF STUDENTS( $f_i$ ) | $C_f$          |
|---------|-----------------------------|----------------|
| 0 - 10  | 8                           | 8              |
| 10 - 20 | 16                          | $8 + 16 = 24$  |
| 20 - 30 | 36                          | $24 + 36 = 60$ |
| 30 - 40 | 34                          | $60 + 34 = 94$ |
| 40 - 50 | 6                           | $94 + 6 = 100$ |
| TOTAL   | 100                         |                |

$$\text{So, } N = 100$$

$$\Rightarrow N/2 = 100/2 = 50$$

The cumulative frequency just greater than ( $N/2 = 50$ ) is 60, so the corresponding median class is 20 - 30 and accordingly we get  $C_f = 24$  (cumulative frequency before the median class).

Now, since median class is 20 - 30.

$$\therefore l = 20, h = 10, f = 36, N/2 = 50 \text{ and } C_f = 24$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 20 + \left( \frac{50-24}{36} \right) \times 10$$

$$= 20 + 7.22$$

$$= 27.22$$

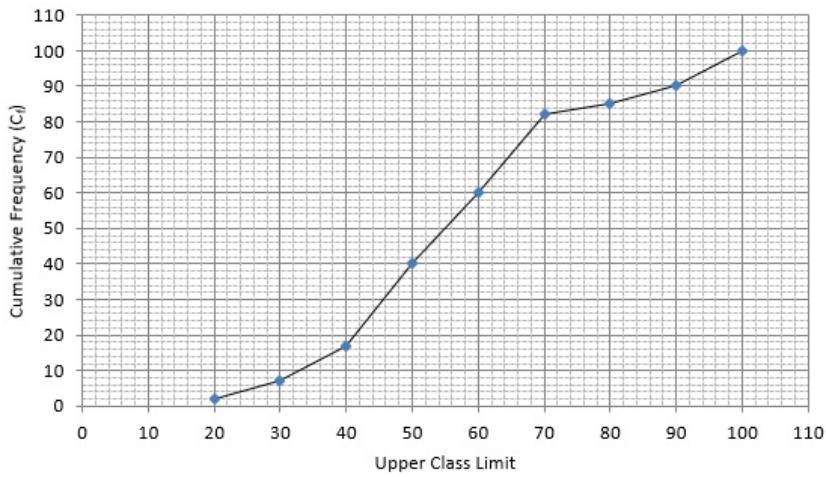
Thus, median is 27.22.

### Question: 15

For the following

#### Solution:

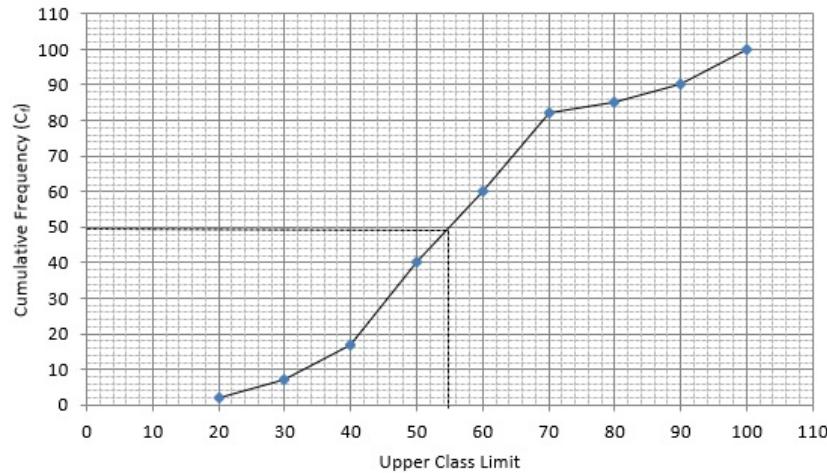
Lets plot a graph of 'less than ogive', taking upper limits of the class intervals on x - axis and cumulative frequencies on y - axis.



As we have  $N = 100$  by the frequency table.

$$N/2 = 100/2 = 50$$

Mark 50 on y - axis and the corresponding point on x - axis would be the median.



The corresponding point on x - axis is 55.

Hence, median is 55.

### Question: 16

The median value

#### Solution:

Given: Median = 35 &  $N = 170$

Assume

$\sum f_i = N = \text{Sum of frequencies}$ ,

$h = \text{length of median class}$ ,

$l = \text{lower boundary of the median class}$ ,

$f = \text{frequency of median class}$

and  $C_f = \text{cumulative frequency}$

Lets form a table, where x and y are the unknown frequencies.

| CLASS   | FREQUENCY( $f_i$ ) | $C_f$                           |
|---------|--------------------|---------------------------------|
| 0 - 10  | 10                 | 10                              |
| 10 - 20 | 20                 | $10 + 20 = 30$                  |
| 20 - 30 | x                  | $30 + x$                        |
| 30 - 40 | 40                 | $30 + x + 40 = 70 + x$          |
| 40 - 50 | y                  | $70 + x + y$                    |
| 50 - 60 | 25                 | $70 + x + y + 25 = 95 + x + y$  |
| 60 - 70 | 15                 | $95 + x + y + 15 = 110 + x + y$ |
| TOTAL   | $110 + x + y$      |                                 |

Median = 35 (as already mentioned in the question)

35 lies between 30 - 40  $\Rightarrow$  Median class = 30 - 40

$\therefore l = 30, h = 10, f = 40, N/2 = (110 + x + y)/2 = 170/2 = 85$  and  $C_f = 30 + x$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow 35 = 30 + \left( \frac{85 - (30 + x)}{40} \right) \times 10$$

$$\Rightarrow 35 = 30 + \left( \frac{85 - 30 - x}{40} \right) \times 10$$

$$\Rightarrow 35 - 30 = (55 - x)/4$$

$$\Rightarrow 5 \times 4 = 55 - x$$

$$\Rightarrow 20 = 55 - x$$

$$\Rightarrow x = 55 - 20 = 35 \dots(i)$$

And given that  $N = 170$

$$\Rightarrow 110 + x + y = 170$$

$$\Rightarrow x + y = 170 - 110$$

$$\Rightarrow x + y = 60 \dots \text{(ii)}$$

Substituting  $x = 35$  in eq.(ii),

$$35 + y = 60$$

$$\Rightarrow y = 60 - 35 = 25$$

Thus, the unknown frequencies are  $x = 35$  and  $y = 25$ .

### Question: 17

Find the missing

#### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS    | MID - POINT( $x_i$ ) | TOTAL FREQUENCY( $f_i$ ) | $f_i x_i$              |
|----------|----------------------|--------------------------|------------------------|
| 0 - 20   | 10                   | 17                       | 170                    |
| 20 - 40  | 30                   | $f_1$                    | $30f_1$                |
| 40 - 60  | 50                   | 32                       | 1600                   |
| 60 - 80  | 70                   | $f_2$                    | $70f_2$                |
| 80 - 100 | 90                   | 19                       | 1710                   |
| TOTAL    |                      | $68 + f_1 + f_2$         | $3480 + 30f_1 + 70f_2$ |

We have got

Mean = 50 and N = 120 (as given in the question)

$$\Sigma f_i = 68 + f_1 + f_2 \text{ and } \Sigma f_i x_i = 3480 + 30f_1 + 70f_2$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow 50 = \frac{3480 + 30f_1 + 70f_2}{68 + f_1 + f_2} (\because \text{given: mean is 50})$$

$$\Rightarrow 3400 + 50f_1 + 50f_2 = 3480 + 30f_1 + 70f_2$$

$$\Rightarrow 50f_1 - 30f_1 + 50f_2 - 70f_2 = 3480 - 3400$$

$$\Rightarrow 20f_1 - 20f_2 = 80$$

$$\Rightarrow f_1 - f_2 = 4 \dots(i)$$

As given in the question, frequency( $\Sigma f_i$ ) = 120

And as calculated by us, frequency ( $\Sigma f_i$ ) =  $68 + f_1 + f_2$

Equalizing them, we get

$$68 + f_1 + f_2 = 120$$

$$\Rightarrow f_1 + f_2 = 120 - 68 = 52$$

$$\Rightarrow f_1 + f_2 = 52 \dots(ii)$$

We will now solve equations (i) and (ii), adding them we get

$$(f_1 + f_2) + (f_1 - f_2) = 52 + 4$$

$$\Rightarrow 2f_1 = 56$$

$$\Rightarrow f_1 = 56/2$$

$$\Rightarrow f_1 = 28$$

Substitute  $f_1 = 28$  in equation (ii),

$$28 + f_2 = 52$$

$$\Rightarrow f_2 = 52 - 28$$

$$\Rightarrow f_2 = 24$$

Thus,  $f_1 = 28$  and  $f_2 = 24$ .

### Question: 18

Find the mean of

#### Solution:

We will find the mean using step - deviation method, where A = Assumed mean and h = length of class interval.

Here, let A = 99 and h = 6

Since, the class intervals are inclusive type, we'll first convert it into exclusive type by extending the class interval from both the ends.

| CLASS     | MID - POINT( $x_i$ ) | DEVIATION( $d_i$ )<br>$d_i = x_i - 99$ | FREQUENCY( $f_i$ ) | $u_i = d_i/h$ | $f_i u_i$ |
|-----------|----------------------|--|--------------------|---------------|-----------|
| 84 - 90   | 87                   | - 12                                   | 15                 | - 2           | - 30      |
| 90 - 96   | 93                   | - 6                                    | 22                 | - 1           | - 22      |
| 96 - 102  | 99 = A               | 0                                      | 20                 | 0             | 0         |
| 102 - 108 | 105                  | 6                                      | 18                 | 1             | 18        |
| 108 - 114 | 111                  | 12                                     | 20                 | 2             | 40        |
| 114 - 120 | 117                  | 18                                     | 25                 | 3             | 75        |
| TOTAL     |                      |  | 120                |               | 81        |

We have got

$$A = 99, h = 6, \sum f_i = 120 \text{ & } \sum f_i u_i = 81$$

∴ mean is given by

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f_i} \times h$$

$$\Rightarrow \bar{x} = 99 + \frac{81}{120} \times 6$$

$$\Rightarrow \bar{x} = 99 + 4.05 = 103.05$$

Thus, mean is 103.05.

### Question: 19

Find the mean, me

### Solution:

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| CLASS   | MID - POINT( $x_i$ ) | FREQUENCY( $f_i$ ) | $f_i x_i$ |
|---------|----------------------|--------------------|-----------|
| 0 - 10  | 5                    | 6                  | 30        |
| 10 - 20 | 15                   | 8                  | 120       |
| 20 - 30 | 25                   | 10                 | 250       |
| 30 - 40 | 35                   | 15                 | 525       |
| 40 - 50 | 45                   | 5                  | 225       |
| 50 - 60 | 55                   | 4                  | 220       |
| 60 - 70 | 65                   | 2                  | 130       |
| TOTAL   |                      | 50                 | 1500      |

We have got

$$\sum f_i = 50 \text{ and } \sum f_i x_i = 1500$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{1500}{50}$$

$$\Rightarrow \bar{x} = 30$$

Thus, mean is 30.

To find median, Assume

$$\sum f_i = N = \text{Sum of frequencies,}$$

$$h = \text{length of median class,}$$

$$l = \text{lower boundary of the median class,}$$

$$f = \text{frequency of median class}$$

$$\text{and } C_f = \text{cumulative frequency}$$

Lets form a table.

| CLASS   | FREQUENCY( $f_i$ ) | $C_f$          |
|---------|--------------------|----------------|
| 0 - 10  | 6                  | 6              |
| 10 - 20 | 8                  | $6 + 8 = 14$   |
| 20 - 30 | 10                 | $14 + 10 = 24$ |
| 30 - 40 | 15                 | $24 + 15 = 39$ |
| 40 - 50 | 5                  | $39 + 5 = 44$  |
| 50 - 60 | 4                  | $44 + 4 = 48$  |
| 60 - 70 | 2                  | $48 + 2 = 50$  |
| TOTAL   | 50                 |                |

We have got

$$\text{So, } N = 50$$

$$\Rightarrow N/2 = 50/2 = 25$$

The cumulative frequency just greater than ( $N/2 = 25$ ) is 39, so the corresponding median class is 30 - 40 and accordingly we get  $C_f = 24$ (cumulative frequency before the median class).

Now, since median class is 30 - 40.

$$\therefore l = 30, h = 10, f = 15, N/2 = 25 \text{ and } C_f = 24$$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 30 + \left( \frac{25-24}{15} \right) \times 10$$

$$= 30 + 0.67$$

$$= 30.67$$

Thus, median is 30.67.

Since, we have got mean = 30 and median = 30.67

Applying the empirical formula,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$\Rightarrow \text{Mode} = 3(30.67) - 2(30)$$

$$\Rightarrow \text{Mode} = 92.01 - 60 = 32.01$$

$\therefore$  Mean = 30, Median = 30.67 and Mode = 32.01

**Question: 20**

Draw 'less than' o

**Solution:**

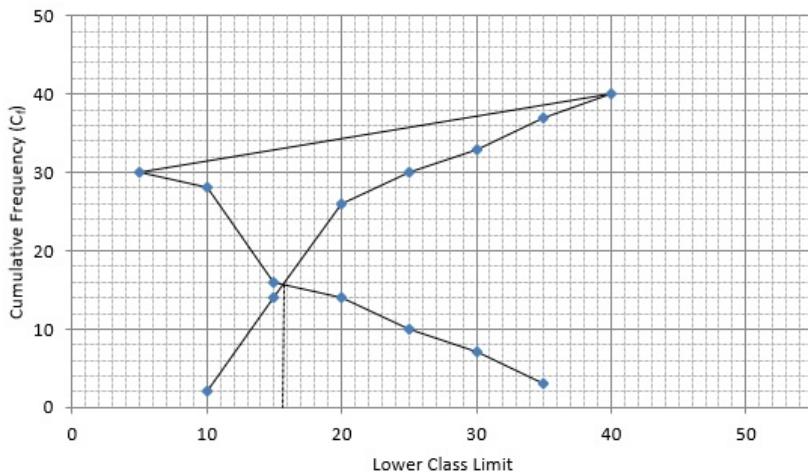
The frequency distribution table for 'less than' type is:

| CLASS        | CUMULATIVE FREQUENCY ( $C_f$ ) |
|--------------|--------------------------------|
| Less than 10 | 2                              |
| Less than 15 | $2 + 12 = 14$                  |
| Less than 20 | $14 + 2 = 26$                  |
| Less than 25 | $26 + 4 = 30$                  |
| Less than 30 | $30 + 3 = 33$                  |
| Less than 35 | $33 + 4 = 37$                  |
| Less than 40 | $37 + 3 = 40$                  |

The frequency distribution table for 'more than' type is:

| CLASS        | CUMULATIVE FREQUENCY ( $C_f$ ) |
|--------------|--------------------------------|
| More than 5  | $28 + 2 = 30$                  |
| More than 10 | $16 + 12 = 28$                 |
| More than 15 | $14 + 2 = 16$                  |
| More than 20 | $10 + 4 = 14$                  |
| More than 25 | $7 + 3 = 10$                   |
| More than 30 | $3 + 4 = 7$                    |
| More than 35 | 3                              |

Plotting points for 'less - than ogive' and 'more - than ogive' on the graph,



In this type of graph where 'less than ogive' and more than ogive' are plotted in the same graph, median is found on x - axis by the intersection of these two ogives.

Here, median = 15.5

### Question: 21

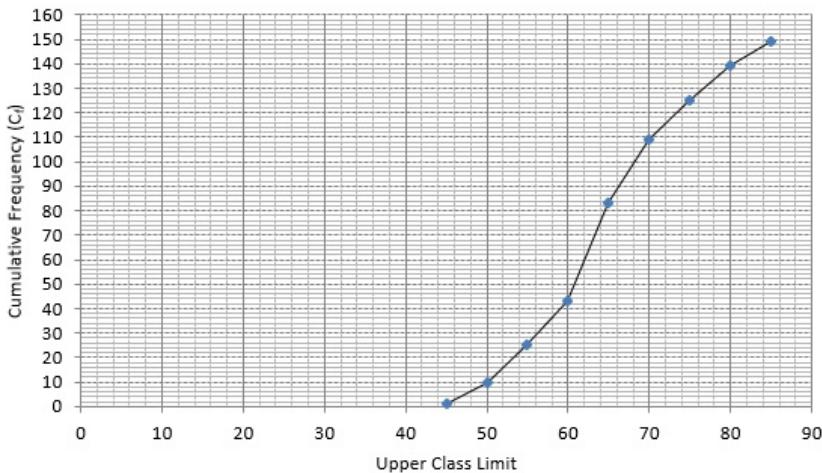
The production  $y_i$

### Solution:

The frequency distribution table for 'less than' type is:

| PRODUCTION YIELD (in kg/ha) | CUMULATIVE FREQUENCY ( $C_f$ ) |
|-----------------------------|--------------------------------|
| Less than 45                | 1                              |
| Less than 50                | $1 + 9 = 10$                   |
| Less than 55                | $10 + 15 = 25$                 |
| Less than 60                | $25 + 18 = 43$                 |
| Less than 65                | $43 + 40 = 83$                 |
| Less than 70                | $83 + 26 = 109$                |
| Less than 75                | $109 + 16 = 125$               |
| Less than 80                | $125 + 14 = 139$               |
| Less than 85                | $139 + 10 = 149$               |

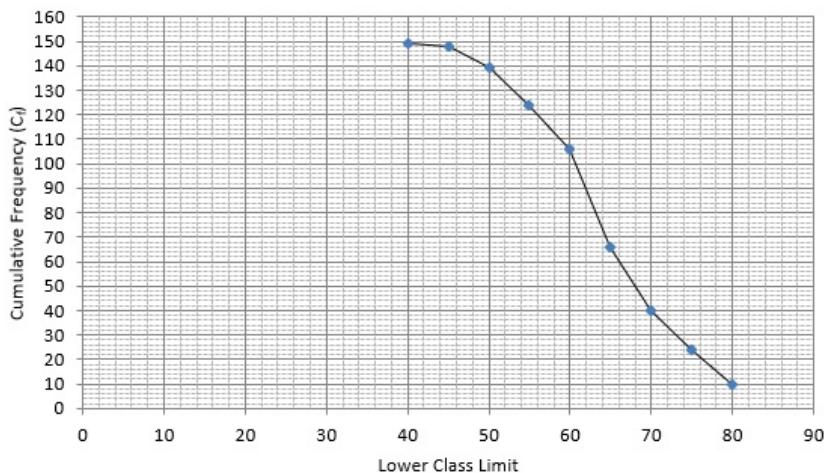
Lets plot the graph of 'less than ogive', taking upper limits of the class intervals on x - axis and cumulative frequencies on y - axis.



The frequency distribution table for 'more than' type is:

| MARKS        | CUMULATIVE FREQUENCY ( $C_f$ ) |
|--------------|--------------------------------|
| more than 40 | $148 + 1 = 149$                |
| more than 45 | $139 + 9 = 148$                |
| more than 50 | $124 + 15 = 139$               |
| more than 55 | $106 + 18 = 124$               |
| more than 60 | $66 + 40 = 106$                |
| more than 65 | $40 + 26 = 66$                 |
| more than 70 | $24 + 16 = 40$                 |
| more than 75 | $10 + 14 = 24$                 |
| more than 80 | 10                             |

Lets plot a graph of 'more than' ogive, taking lower limits of the class intervals on x - axis and cumulative frequencies on y - axis.



**Question: 22**

The following tab

**Solution:**

For equal class intervals, we will solve by finding mid points of these classes using direct method.

| MARKS       | MID - POINT( $x_i$ ) | NUMBER OF STUDENTS( $f_i$ ) | $f_i x_i$ |
|-------------|----------------------|-----------------------------|-----------|
| 10.5 - 15.5 | 13                   | 2                           | 26        |
| 15.5 - 20.5 | 18                   | 3                           | 54        |
| 20.5 - 25.5 | 23                   | 6                           | 138       |
| 25.5 - 30.5 | 28                   | 4                           | 112       |
| 30.5 - 35.5 | 33                   | 14                          | 462       |
| 35.5 - 40.5 | 38                   | 12                          | 456       |
| 40.5 - 45.5 | 43                   | 4                           | 172       |
| 45.5 - 50.5 | 48                   | 2                           | 96        |
| TOTAL       |                      | 47                          | 1516      |

We have got

$$\Sigma f_i = 47 \text{ and } \Sigma f_i x_i = 1516$$

$\therefore$  mean is given by

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$\Rightarrow \bar{x} = \frac{1516}{47}$$

$$\Rightarrow \bar{x} = 32.26$$

Thus, mean is 32.26.

To find median, Assume

$\Sigma f_i = N$  = Sum of frequencies,

$h$  = length of median class,

$l$  = lower boundary of the median class,

$f$  = frequency of median class

and  $C_f$  = cumulative frequency

Lets form a table.

| MARKS       | NUMBER OF STUDENTS( $f_i$ ) | NUMBER OF STUDENTS( $f_i$ ) |
|-------------|-----------------------------|-----------------------------|
| 10.5 - 15.5 | 2                           | 2                           |
| 15.5 - 20.5 | 3                           | $2 + 3 = 5$                 |
| 20.5 - 25.5 | 6                           | $5 + 6 = 11$                |
| 25.5 - 30.5 | 4                           | $11 + 4 = 15$               |
| 30.5 - 35.5 | 14                          | $15 + 14 = 29$              |
| 35.5 - 40.5 | 12                          | $29 + 12 = 41$              |
| 40.5 - 45.5 | 4                           | $41 + 4 = 45$               |
| 45.5 - 50.5 | 2                           | $45 + 2 = 47$               |
| TOTAL       | 47                          |                             |

We have got

So,  $N = 47$

$$\Rightarrow N/2 = 47/2 = 23.5$$

The cumulative frequency just greater than ( $N/2 = 23.5$ ) is 29, so the corresponding median class is 30.5 - 35.5 and accordingly we get  $C_f = 15$  (cumulative frequency before the median class).

Now, since median class is 30.5 - 35.5.

$\therefore l = 30.5$ ,  $h = 5$ ,  $f = 14$ ,  $N/2 = 23.5$  and  $C_f = 15$

Median is given by,

$$\text{Median} = l + \left( \frac{\frac{N}{2} - C_f}{f} \right) \times h$$

$$\Rightarrow \text{Median} = 30 + \left( \frac{23.5 - 15}{14} \right) \times 5$$

$$= 30 + 3.03$$

$$= 33.03$$

Thus, median is 33.03.

Since, we have got mean = 32.26 and median = 33.03

Applying the empirical formula,

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean})$$

$$\Rightarrow \text{Mode} = 3(33.03) - 2(32.26)$$

$$\Rightarrow \text{Mode} = 99.09 - 64.52 = 34.57$$

$\therefore$  Mean = 32.26, Median = 33.03 and Mode = 34.57